5.3.1.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

This section describes the results for Waste Management Alternative 3, including long-term groundwater impacts of contaminant sources within the IDF-East, IDF-West, and RPPDF barriers. Impacts of sources remaining within the tank farm barriers are presented in Section 5.1, which discusses tank closure impacts. Impacts of sources remaining within the FFTF barrier are presented in Section 5.2, which discusses FFTF decommissioning impacts.

Waste Management Alternative 3 is designed to show the impacts of waste disposal at an IDF in the 200-East Area and an IDF in the 200-West Area. Summaries of the proposed actions and timelines for Waste Management Alternative 3 are provided in Chapter 2, Section 2.5. There are three disposal facilities, as follows:

- Two IDFs, one in the south-central part of the 200-East Area (IDF-East), which would receive tank waste, and the other in the northern part of the 200-West Area (IDF-West), which would receive FFTF decommissioning waste; onsite non-CERCLA waste; and offsite LLW and MLLW. The LLW and MLLW inventories for trenches 31 and 34 are also included in the IDF inventory in this analysis.

- The RPPDF, located in the Core Zone between the 200-East and 200-West Areas, which would receive lightly contaminated equipment and soils resulting from tank farm closure activities.

Three disposal groups were analyzed. Each has a different configuration and timeline for the IDFs and RPPDF. The three disposal groups are discussed in detail in the following subsections.

5.3.1.3.1 Disposal Group 1

Disposal Group 1 is characterized by an operational completion date of CY 2050 for IDF-East, IDF-West, and the RPPDF. Under Disposal Group 1, IDF-West would have a large capacity (90,000 cubic meters [117,720 cubic yards]); IDF-East, a larger capacity (1,300,000 cubic meters [1,700,400 cubic yards]); and the RPPDF, a capacity of 1,080,000 cubic meters (1,412,640 cubic yards). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 2B, 3A, 3B, 3C, 4, 5, or 6C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

5.3.1.3.1.1 Disposal Group 1, Subgroup 1-A

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 2B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW and ILAW glass.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West,

and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable; they are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Four subtotals are plotted in Figures 5–713 through 5–718, representing releases from IDF-East, which include ILAW glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

Figure 5–713 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–714, the chemical hazard drivers. For all four sources, the release to the vadose zone is controlled by retention within the waste form (i.e., less than 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and chromium is tank closure secondary waste. For iodine-129 and nitrate, ETF-generated secondary waste is the predominant source. Fluoride is not released from IDF-East.

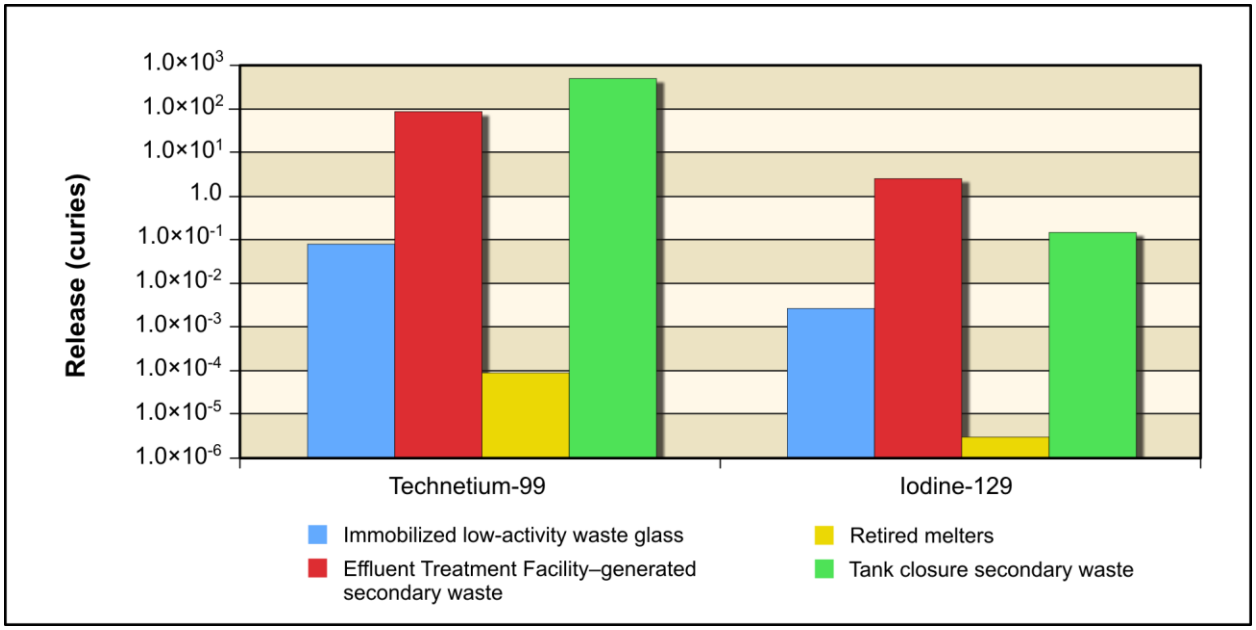


Figure 5–713. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

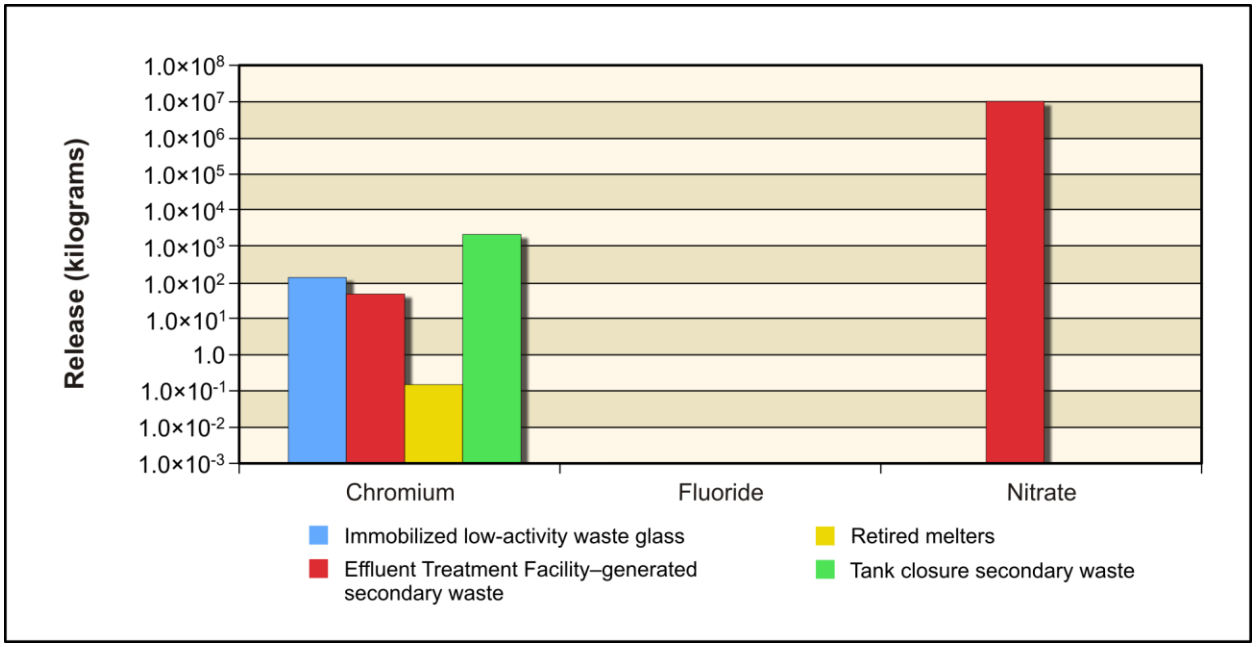


Figure 5–714. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–715 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–716, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 60 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

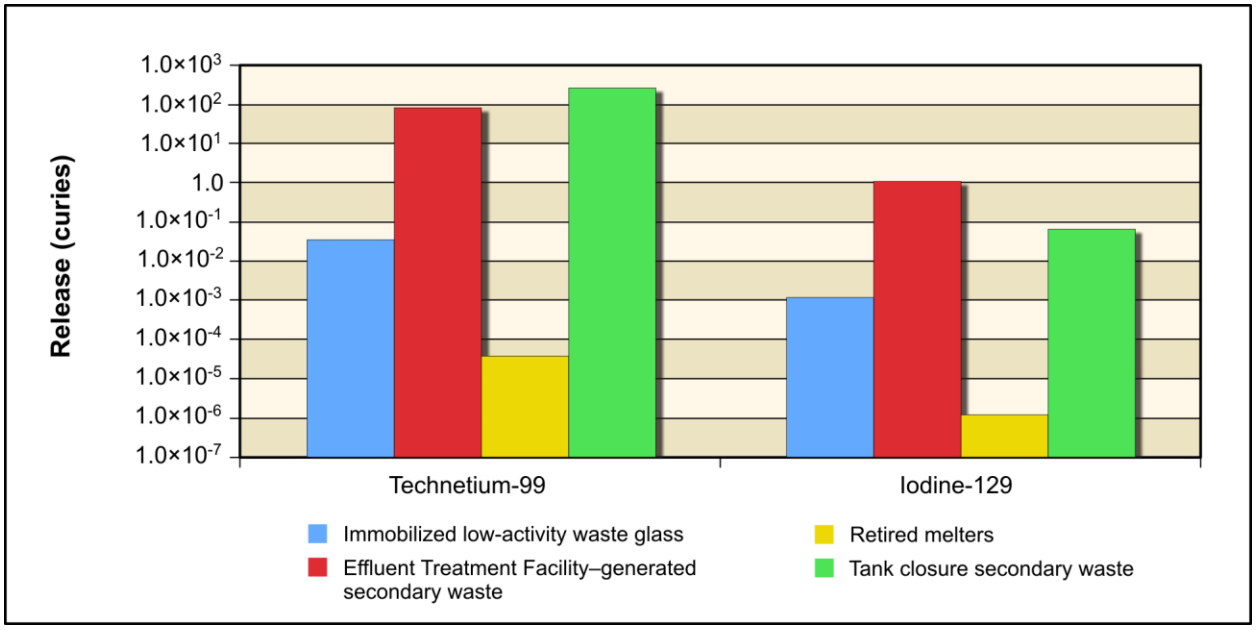


Figure 5–715. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

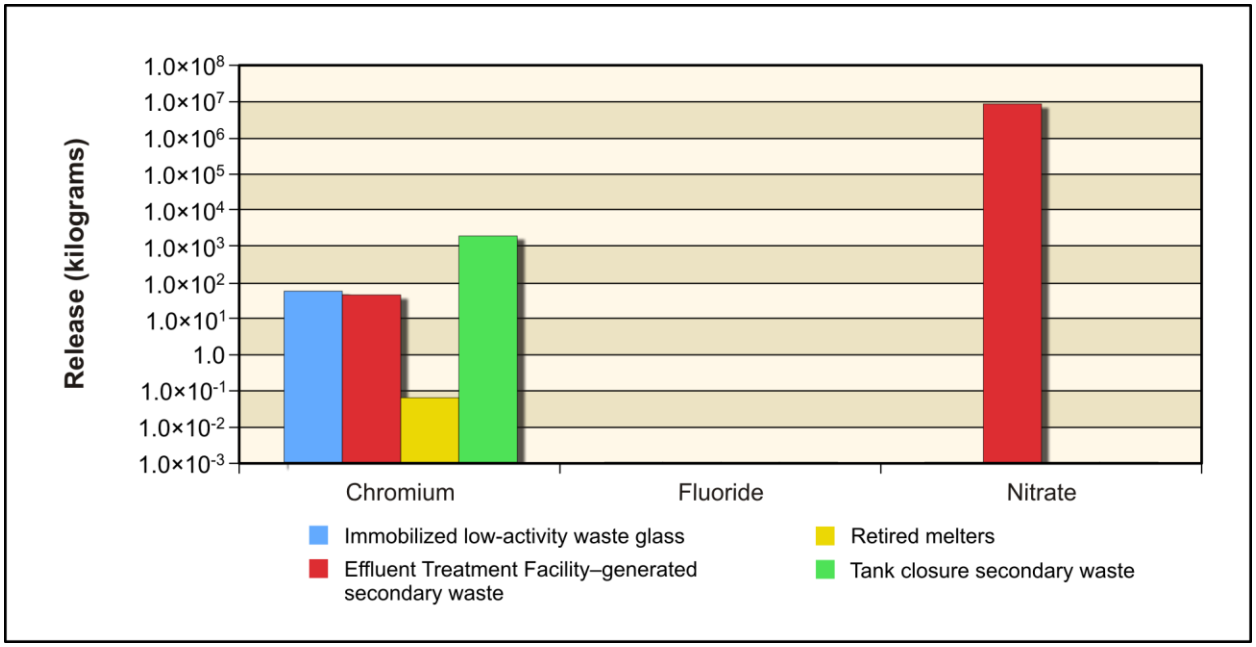


Figure 5–716. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–717 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–718, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the total amount released to the Columbia River is essentially equal to the total amount released to groundwater. The contribution from waste from retired melters for technetium-99 and iodine-129 is very small, and releases to groundwater from the retired melters in small amounts reach the Columbia River. About 96 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; approximately 99 percent of the chemical quantity (kilograms) reaches the river.

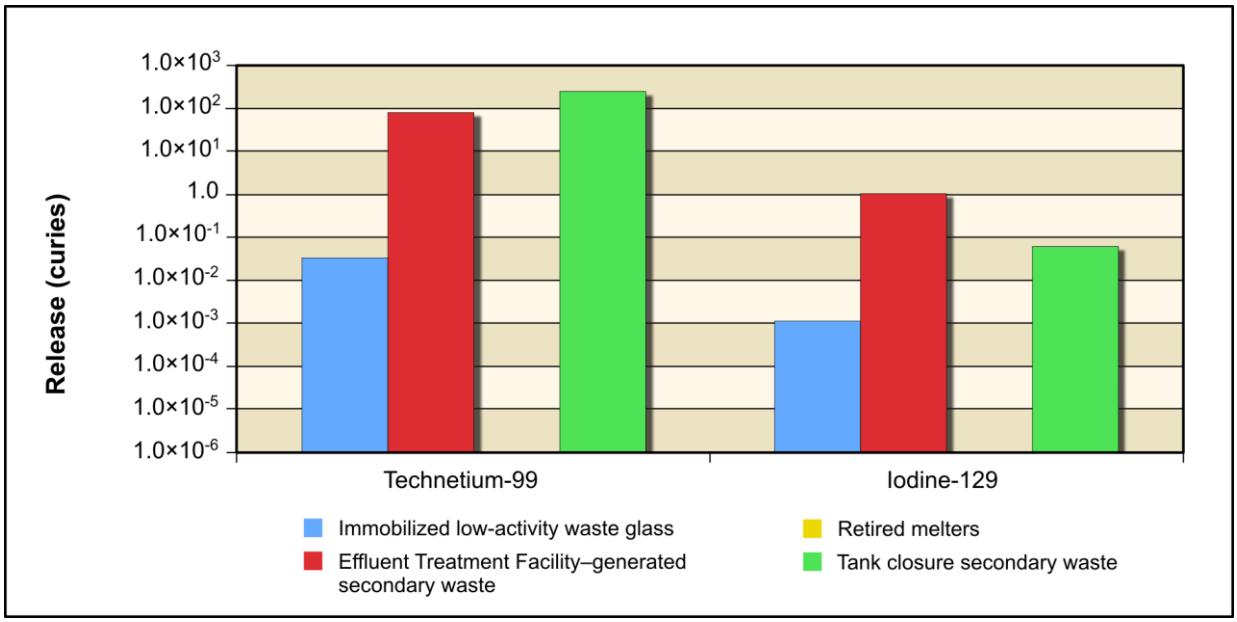


Figure 5–717. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

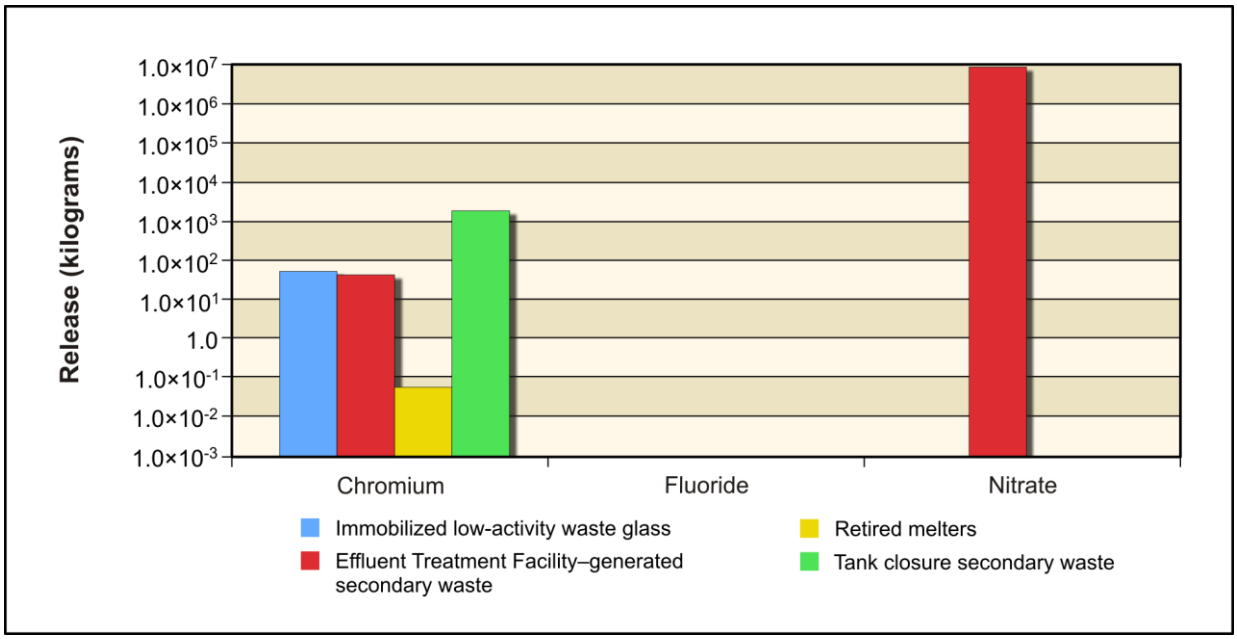


Figure 5–718. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–719 through 5–724, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management and onsite waste, and offsite waste.

Figure 5–719 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–720, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. For chromium, nitrate, and fluoride, the predominant source is waste management secondary waste and onsite waste.

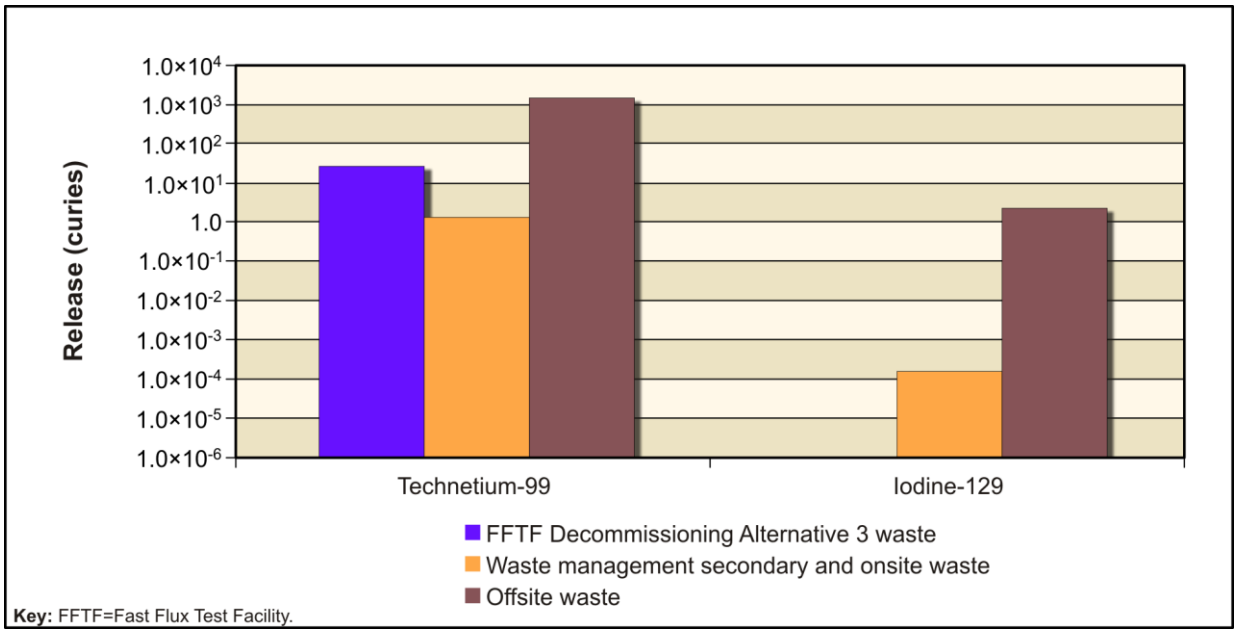


Figure 5–719. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

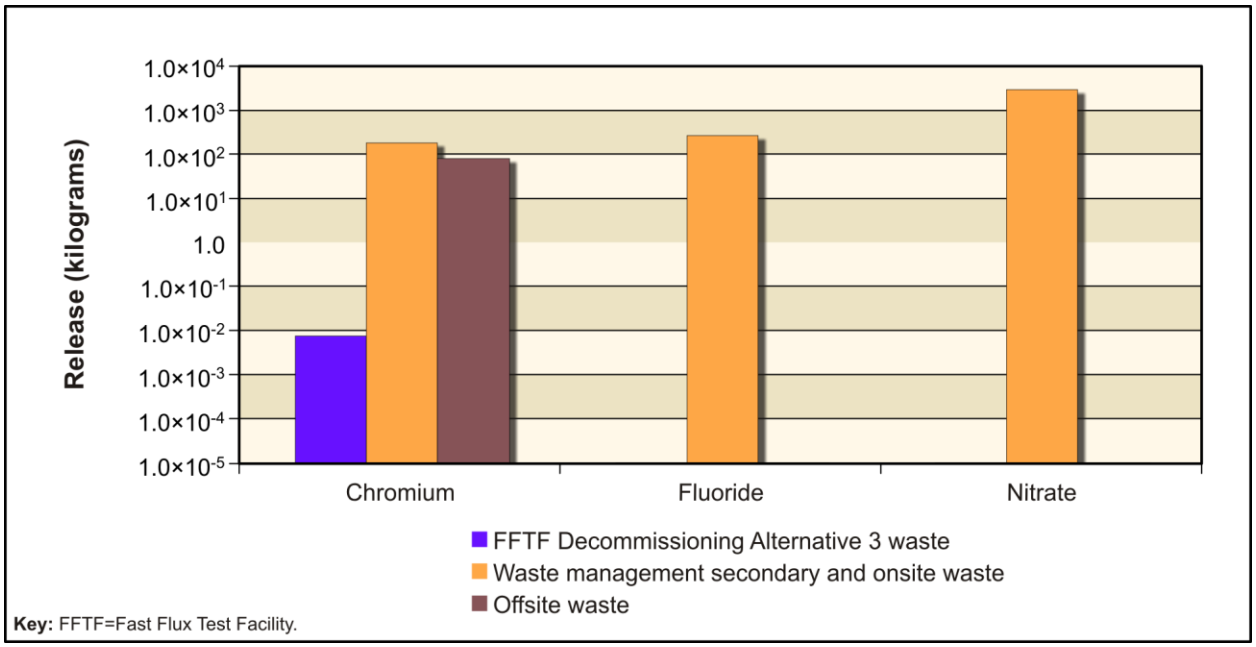


Figure 5–720. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–721 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–722, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, nitrate, and fluoride, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 97 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

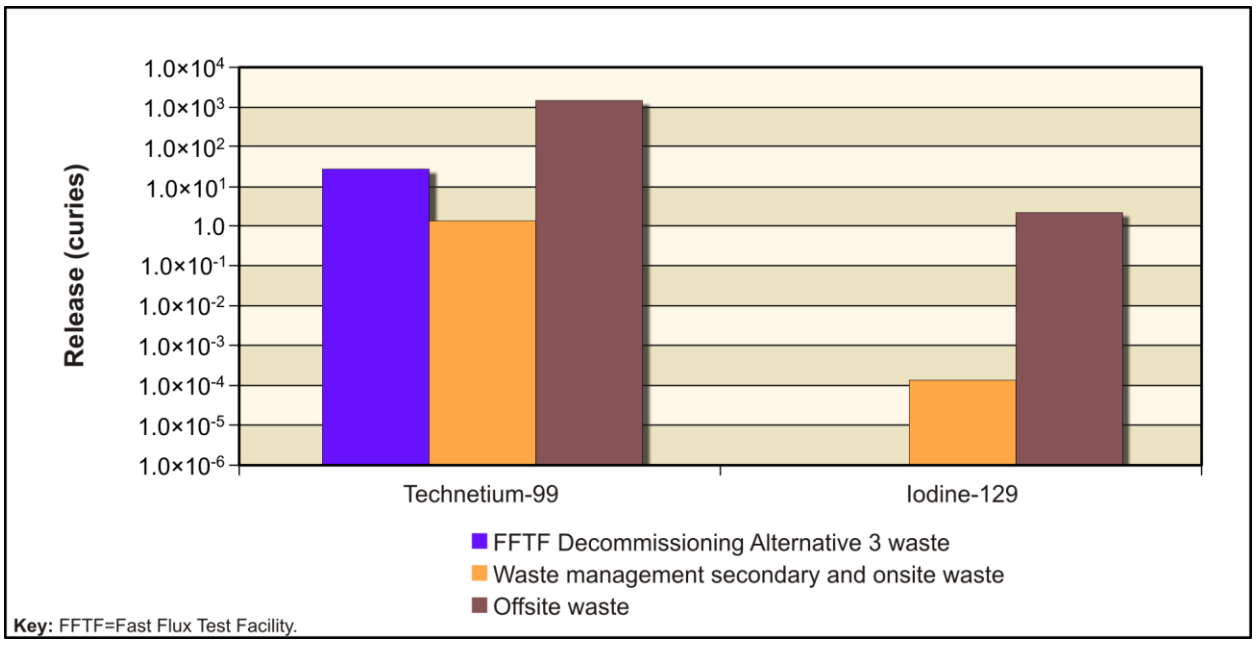


Figure 5–721. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

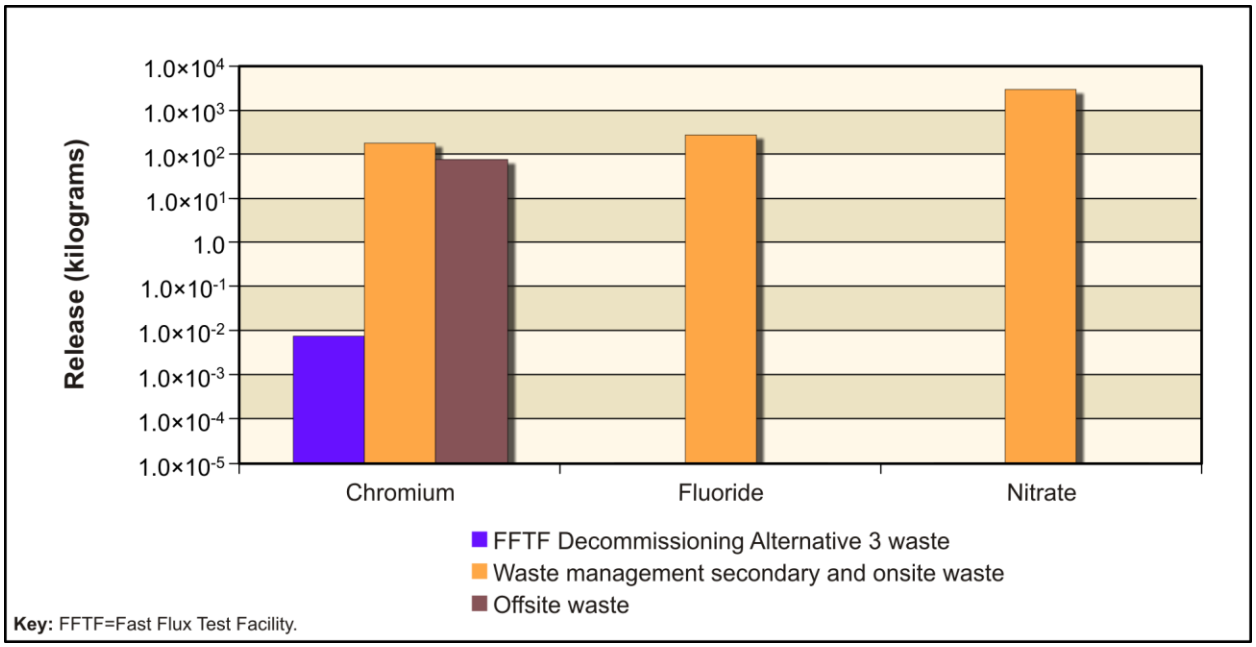


Figure 5–722. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–723 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–724, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, nitrate, and fluoride, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 99 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river, while approximately 100 percent of the chemical quantity (kilograms) reaches the river.

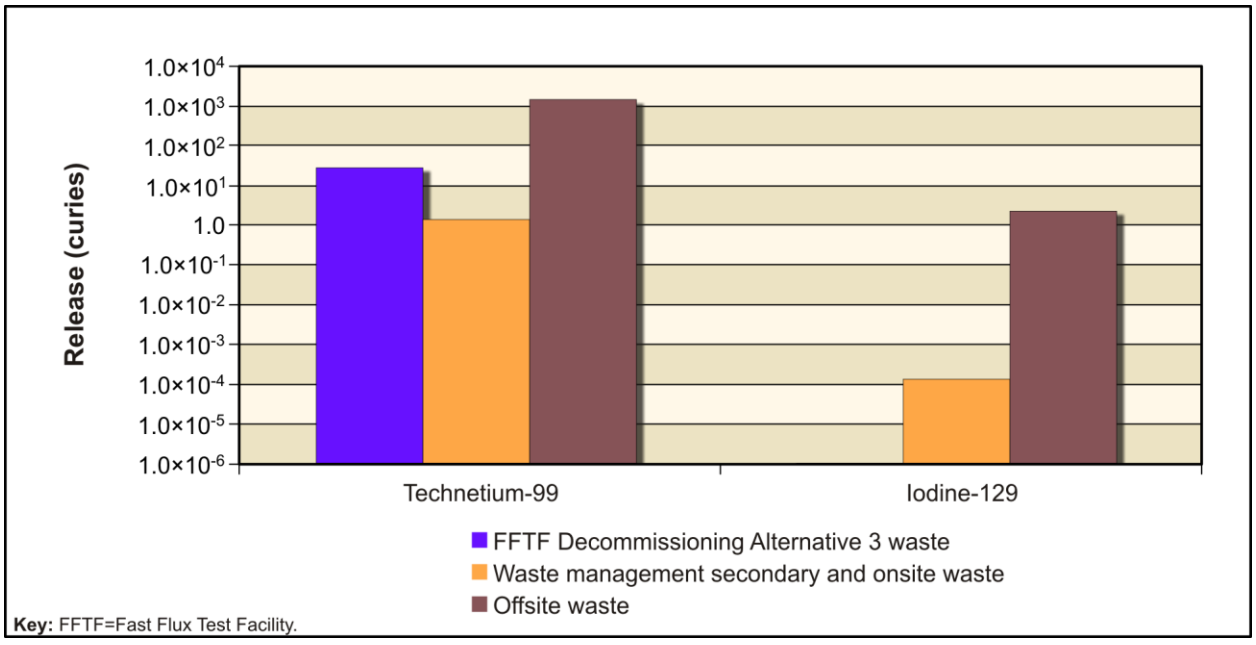


Figure 5–723. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

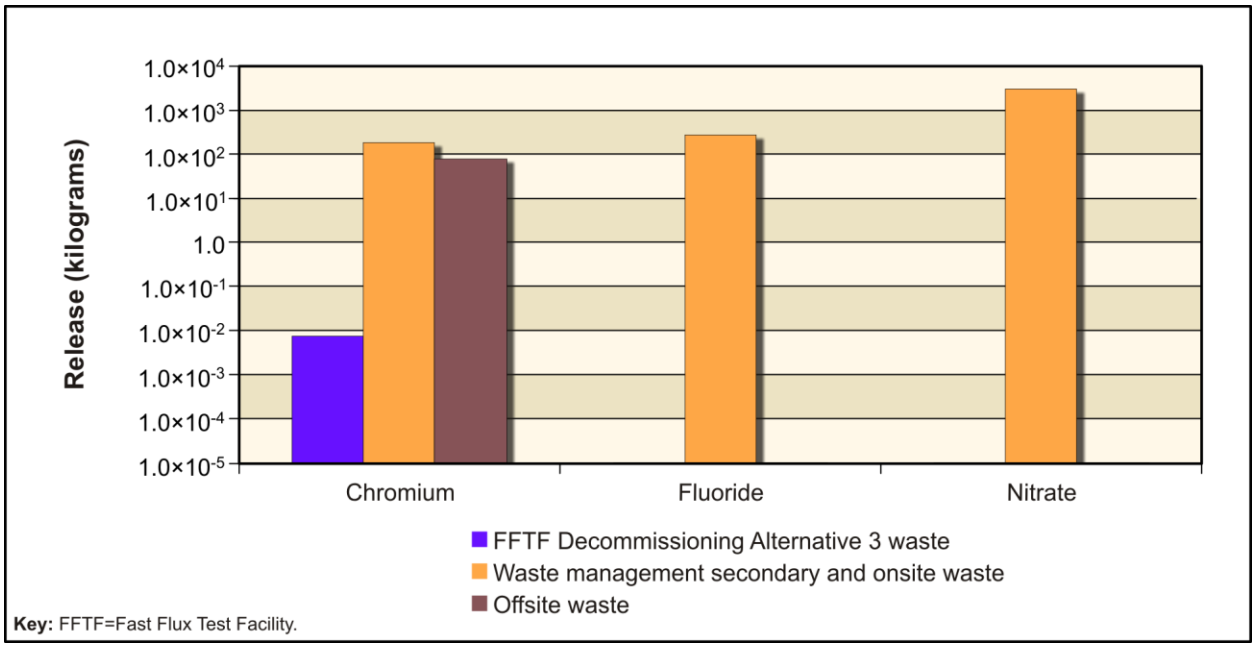


Figure 5–724. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–725 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–726, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). Fluoride is not released from the RPPDF.

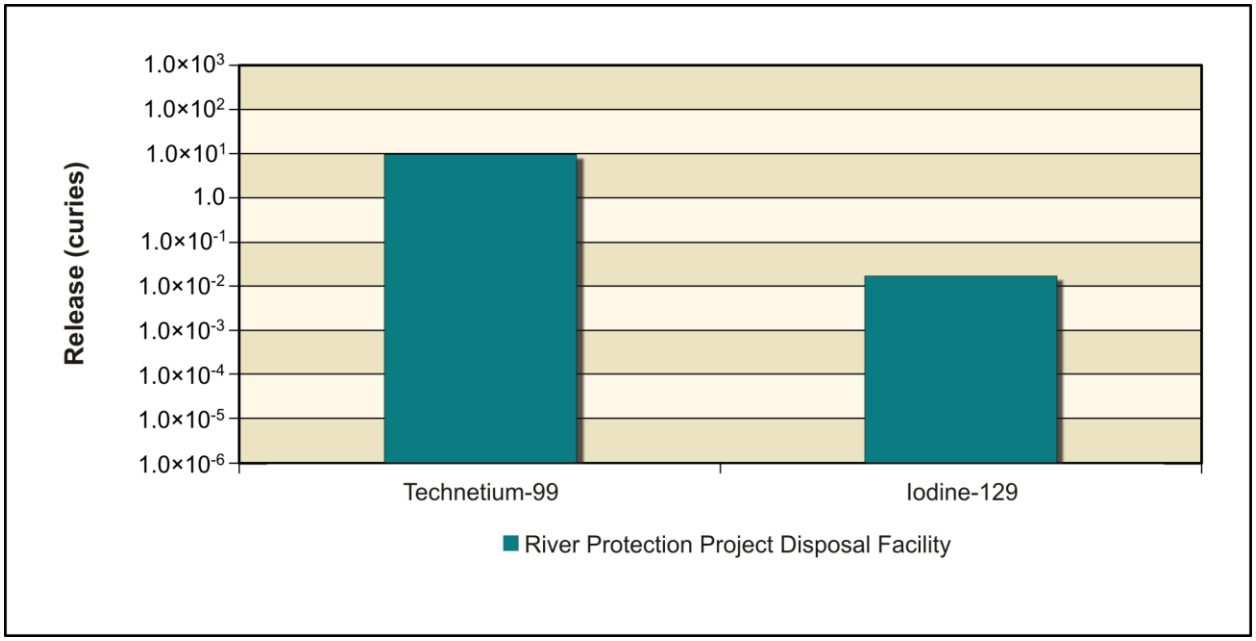


Figure 5–725. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

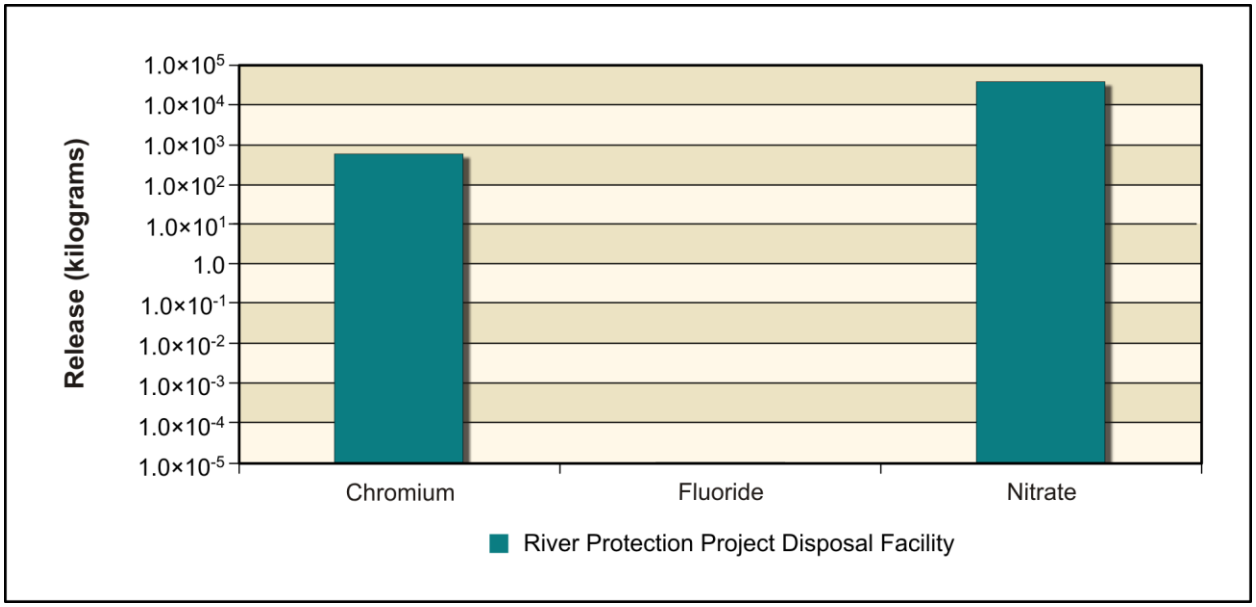


Figure 5–726. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–727 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–728, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

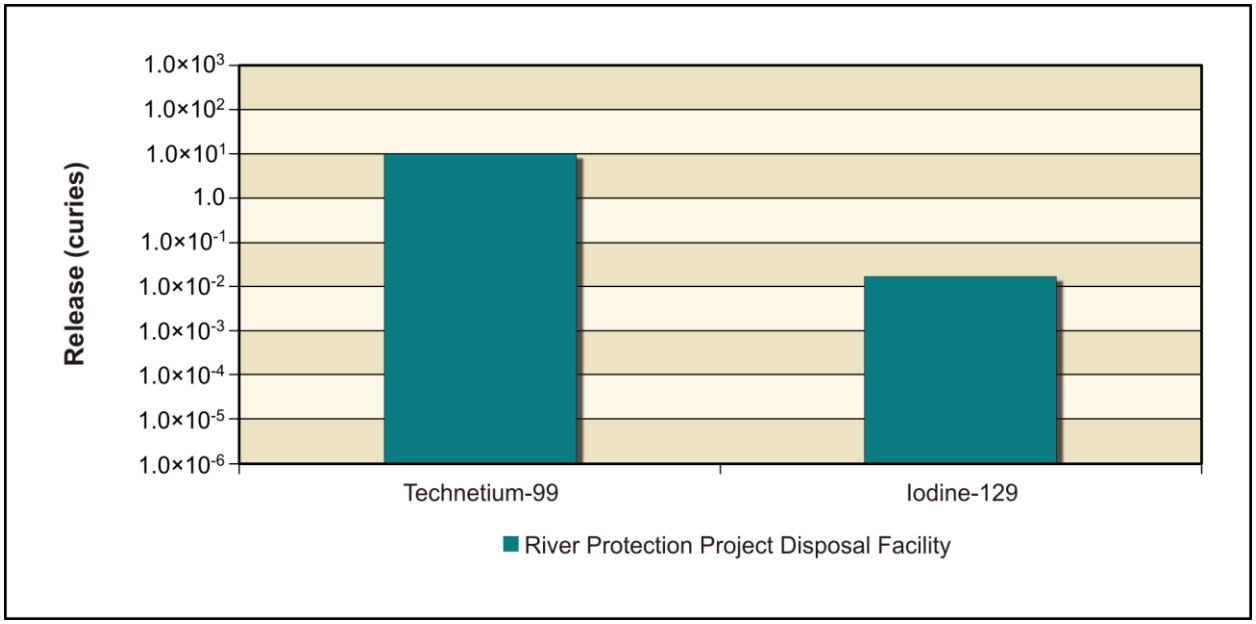


Figure 5–727. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

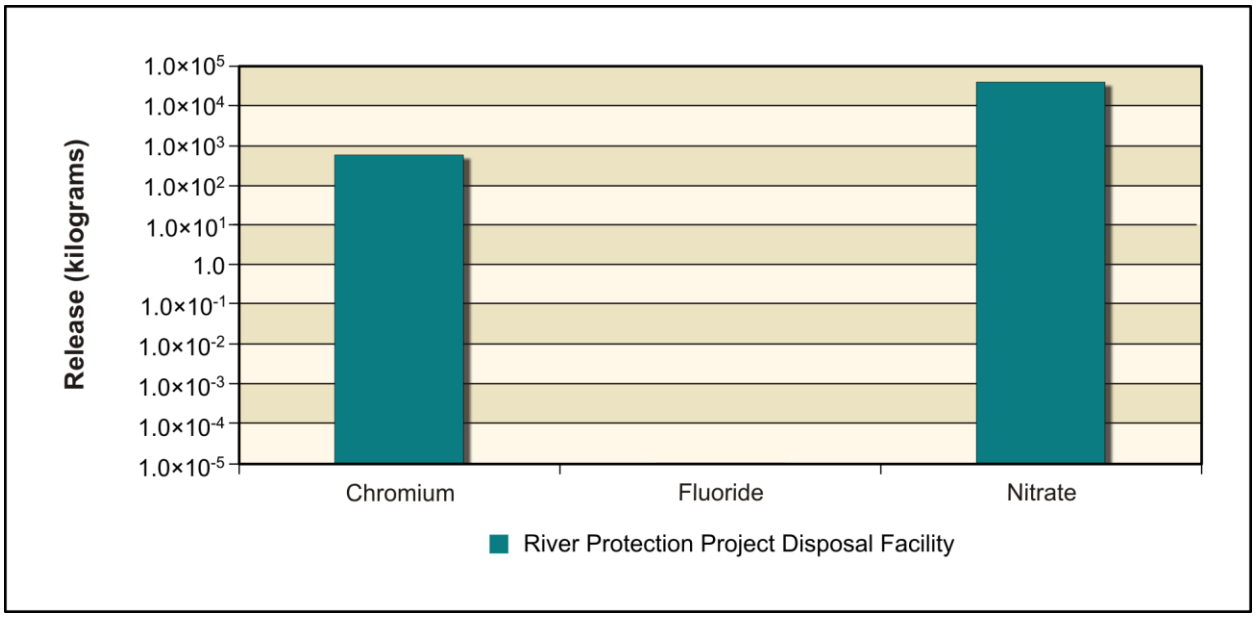


Figure 5–728. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–729 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–730, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. Overall, approximately 100 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; about 100 percent of the chemical quantity (kilograms) reaches the river.

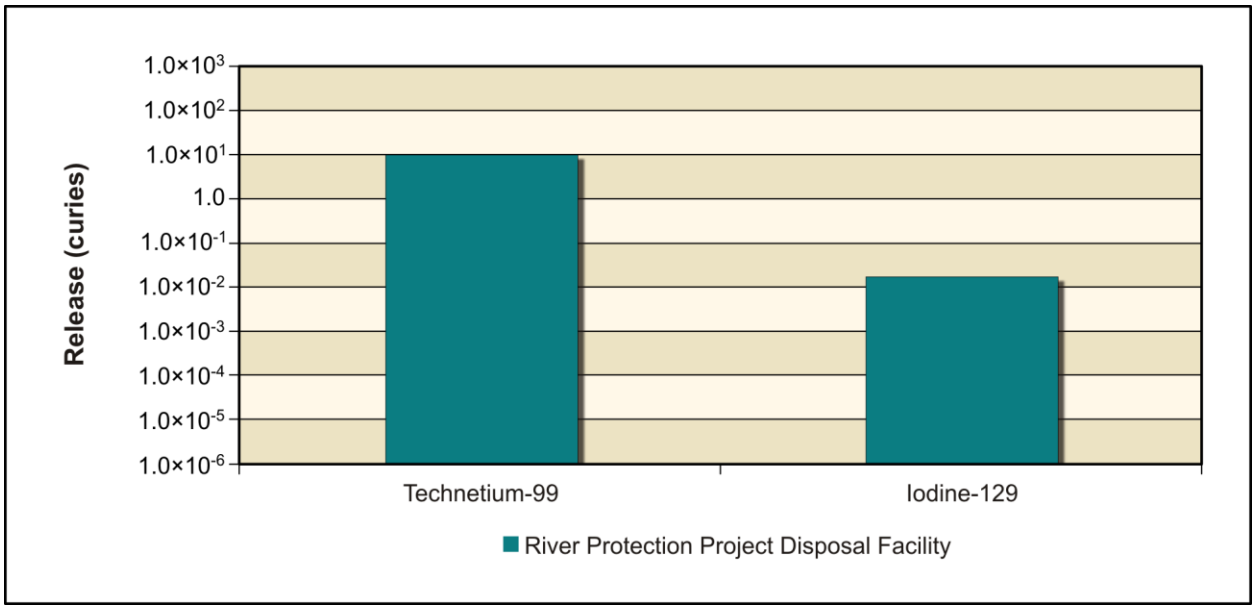


Figure 5–729. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

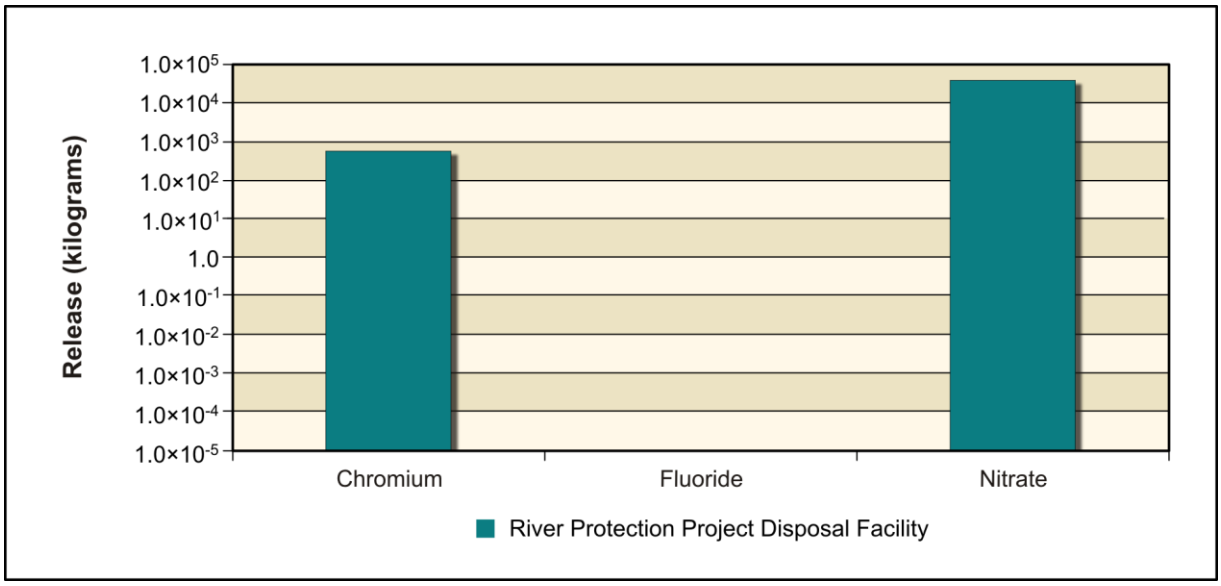


Figure 5–730. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–106 lists the maximum concentrations of the COPCs in the peak year at IDF-East, IDF-West, the RPPDF, the Core Zone Boundary, and the Columbia River nearshore. Exceedances of the benchmarks occur only for technetium-99 and iodine-129 at IDF-East, IDF-West, the Core Zone Boundary, and the Columbia River nearshore.

Table 5–106. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	206	**13,200**	42	**1,370**	**1,670**	900
	(10,129)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	1.0	**20.6**	0.1	**2.1**	**2.4**	1
	(10,177)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	3	1	0	100
	(8438)	(3813)	(3740)	(3846)	(4481)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	12,100	7	180	3,010	2,030	45,000
	(7962)	(3927)	(3670)	(8248)	(7535)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–731 through 5–734 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 4800. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6000. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is approximately 1,300 years. Nitrate and chromium do not exceed benchmark concentrations at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

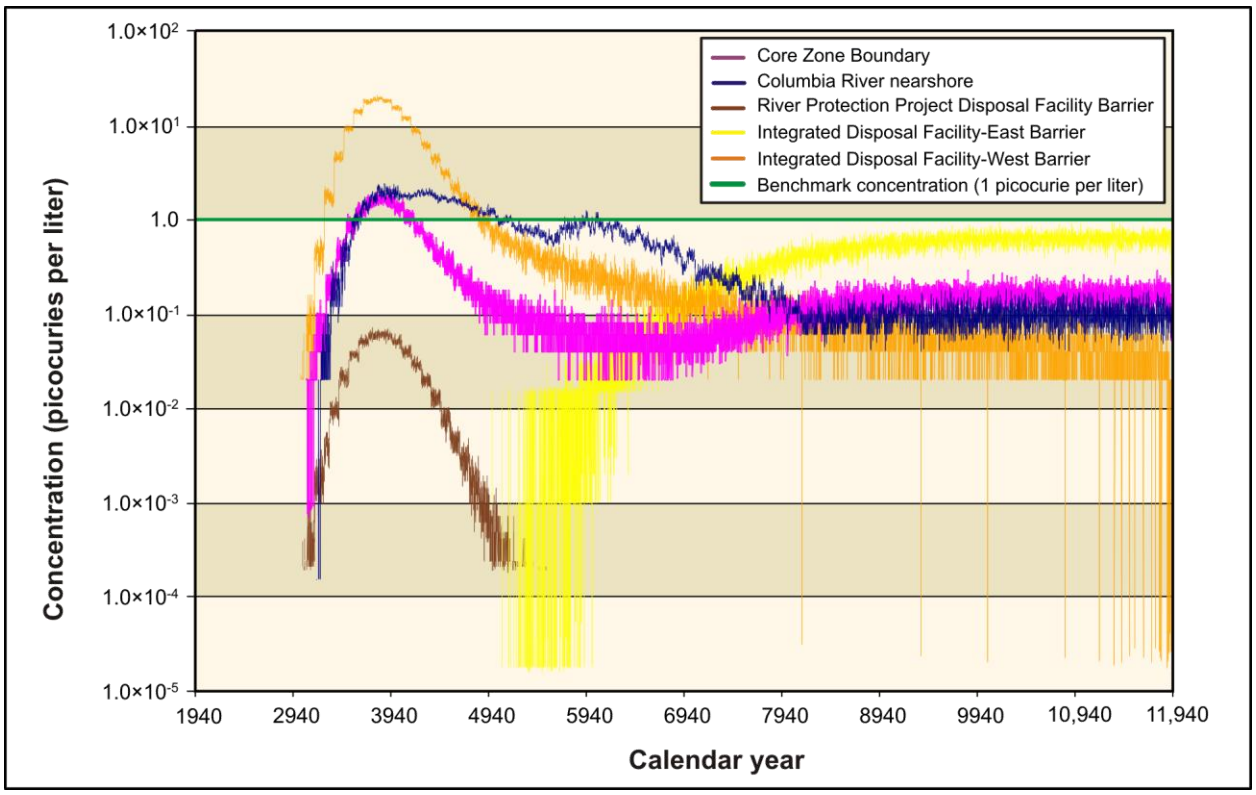


Figure 5–731. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time

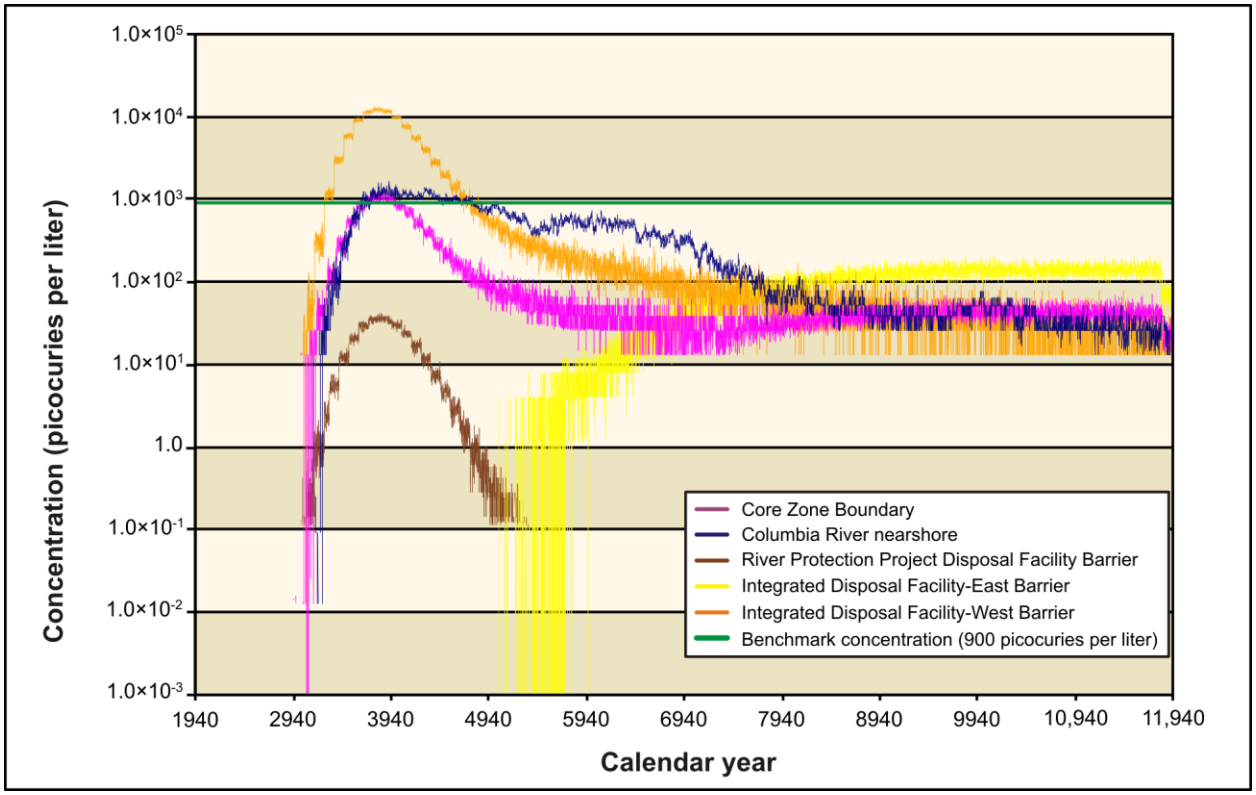


Figure 5–732. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time

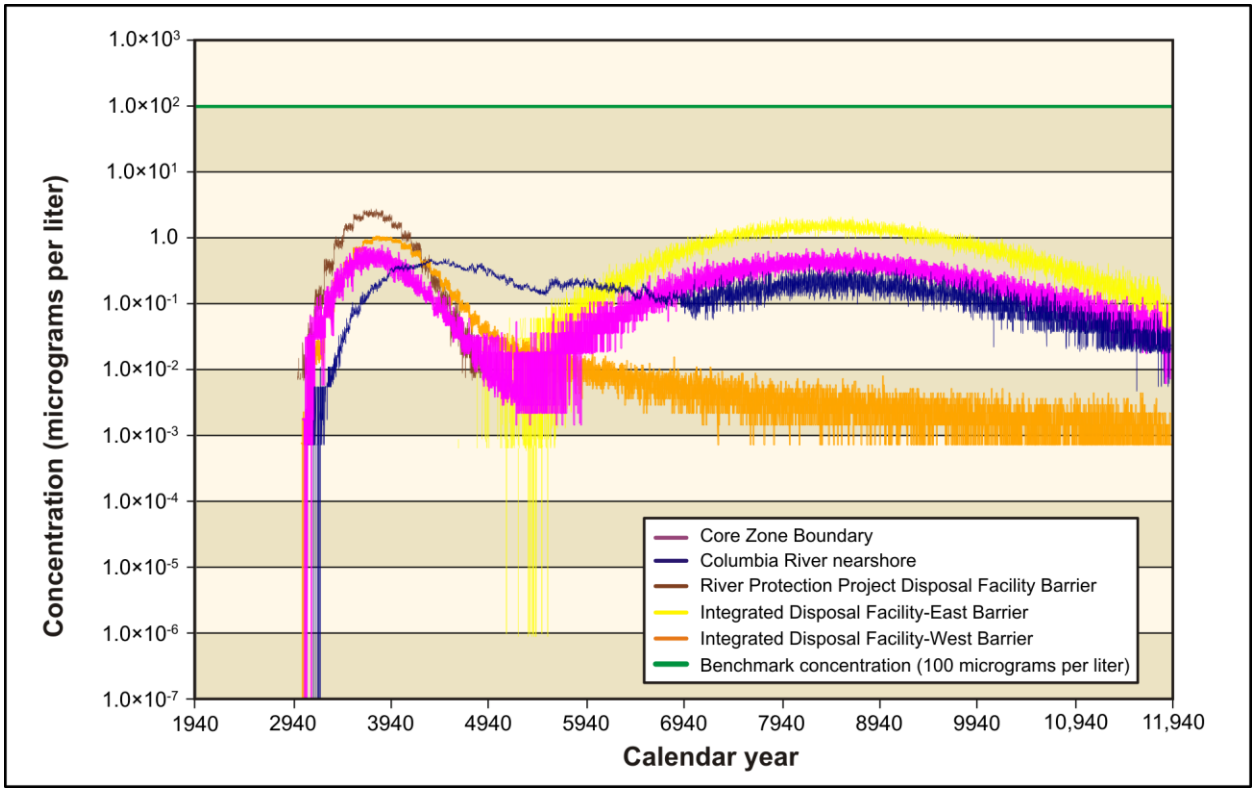


Figure 5–733. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chromium Concentration Versus Time

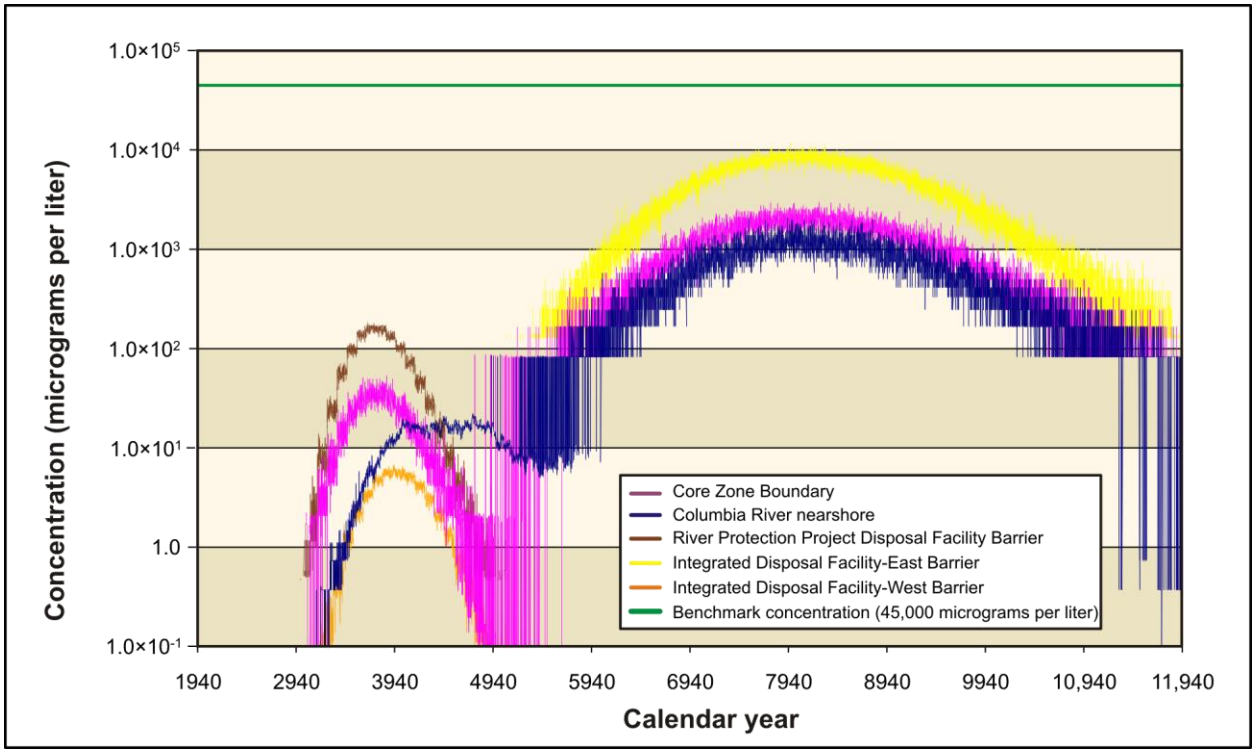


Figure 5–734. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Nitrate Concentration Versus Time

Figure 5–735 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that remain below about eight orders of magnitude lower than benchmark concentrations at the RPPDF barrier and Core Zone Boundary for the duration of the 10,000-year simulation period.

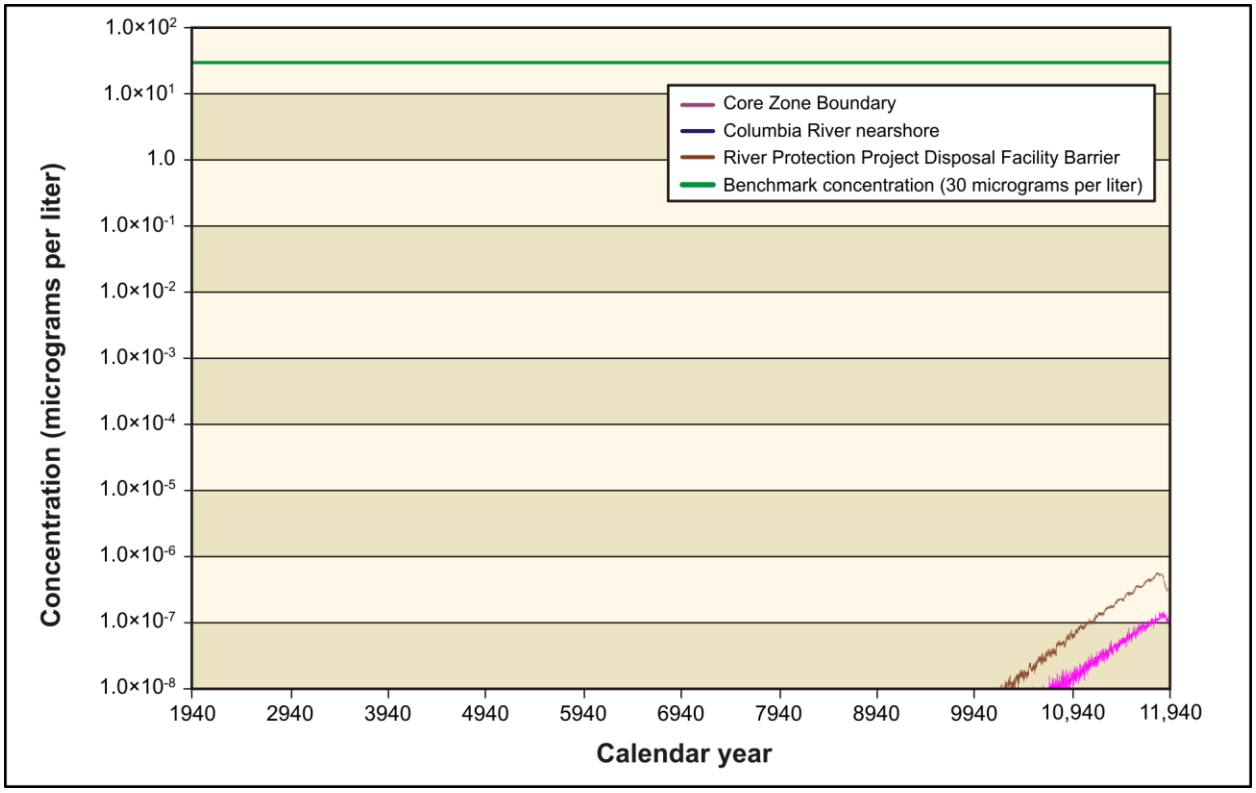
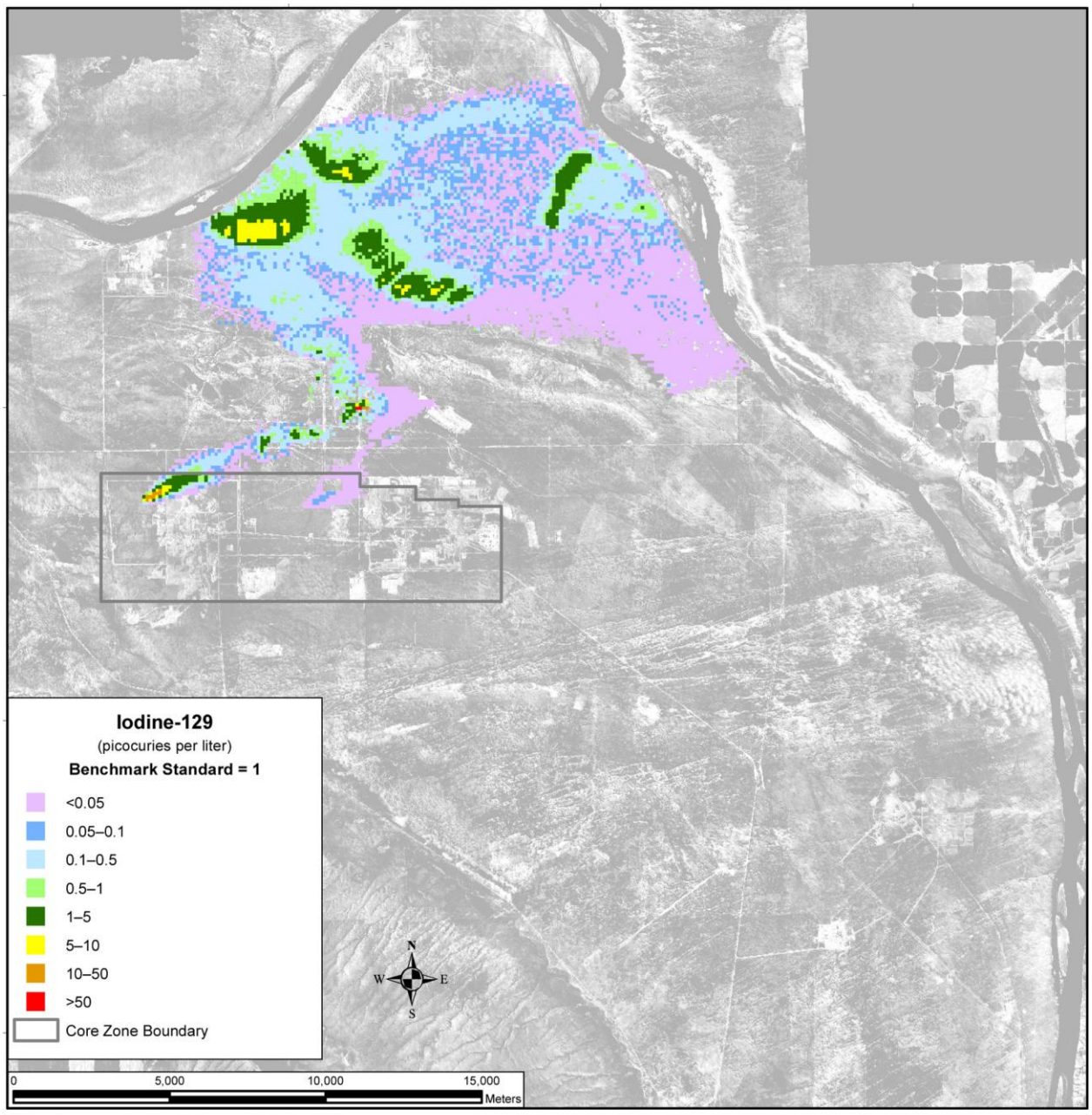


Figure 5–735. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

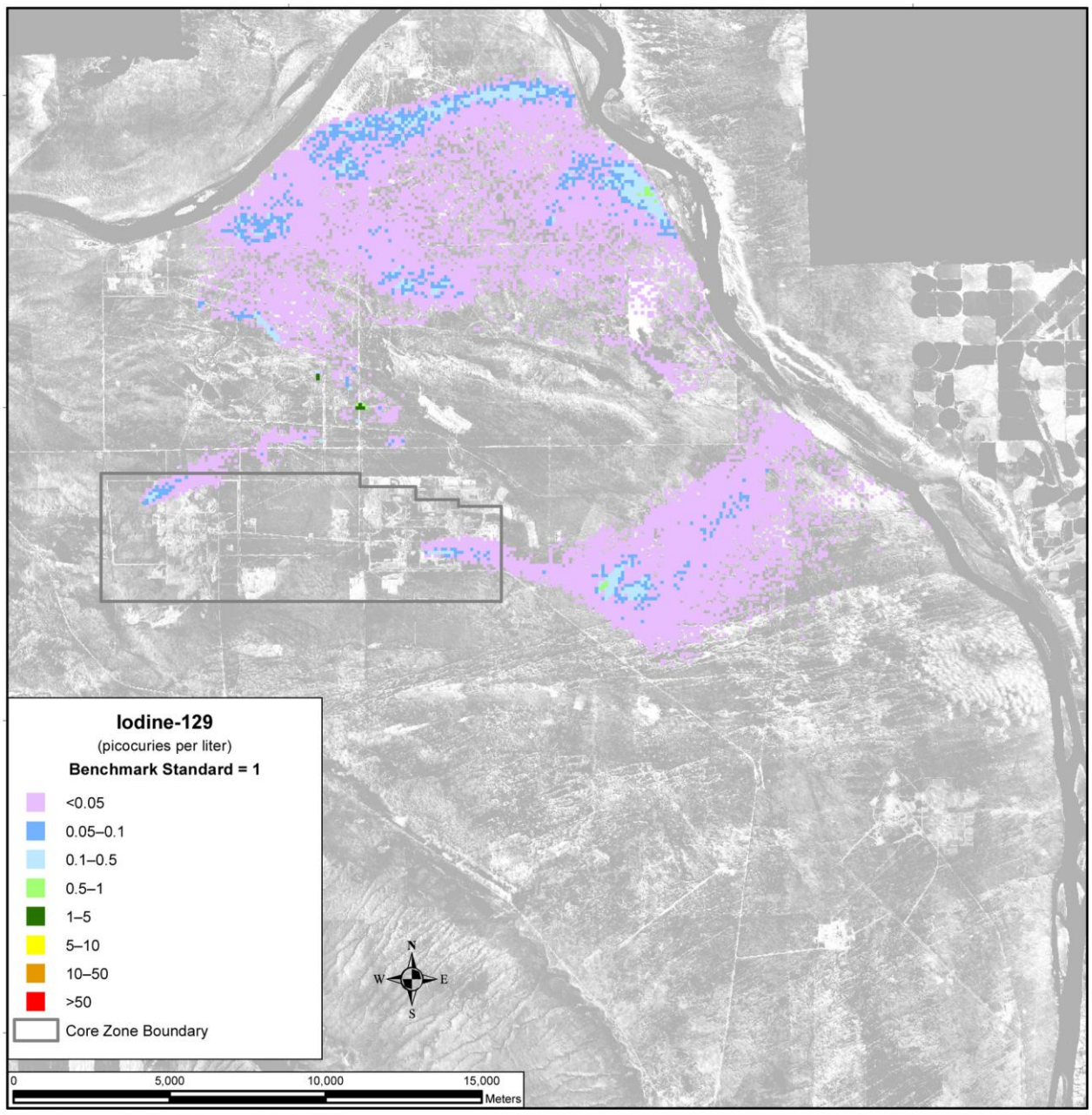
This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figure 5–736 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Mountain. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–737). Also by CY 7140, most of the IDF-West and RPPDF plume continues to move north and reaches the Columbia River. By CY 11,885, most of the mass in the IDF-East plume is still moving east toward the Columbia River, with only small, isolated pockets of concentration exceeding the benchmark (see Figure 5–738). Technetium-99 (see Figures 5–739 through 5–741) shows similar spatial distributions at selected times and exceeds its benchmark concentration at approximately the same time and locations. Chromium (see Figures 5–742 through 5–744) and nitrate (see Figures 5–745 through 5–747) show similar spatial distributions at selected times, but neither exceeds its benchmark concentration. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



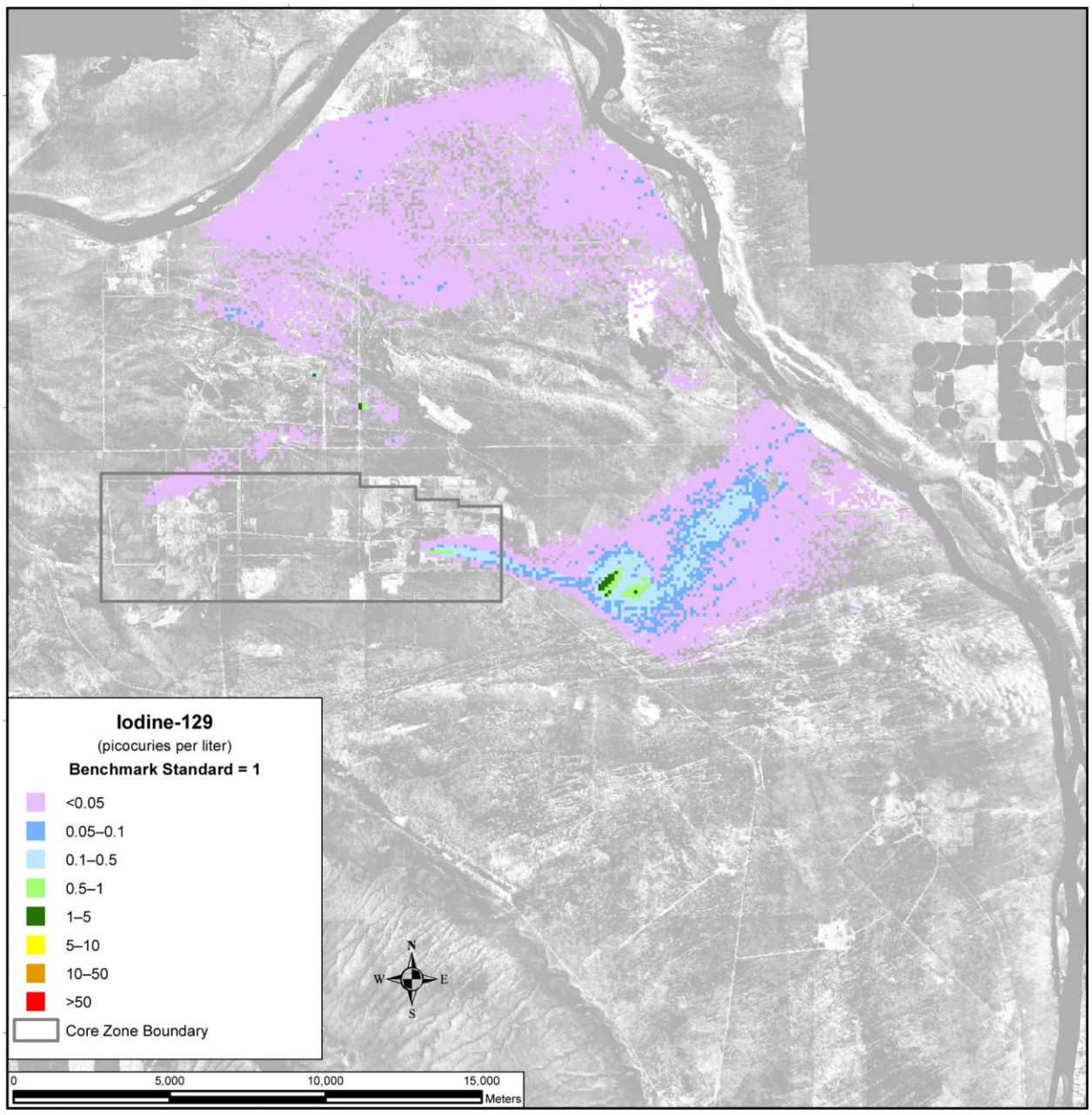
Note: To convert meters to feet, multiply by 3.281.

Figure 5–736. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



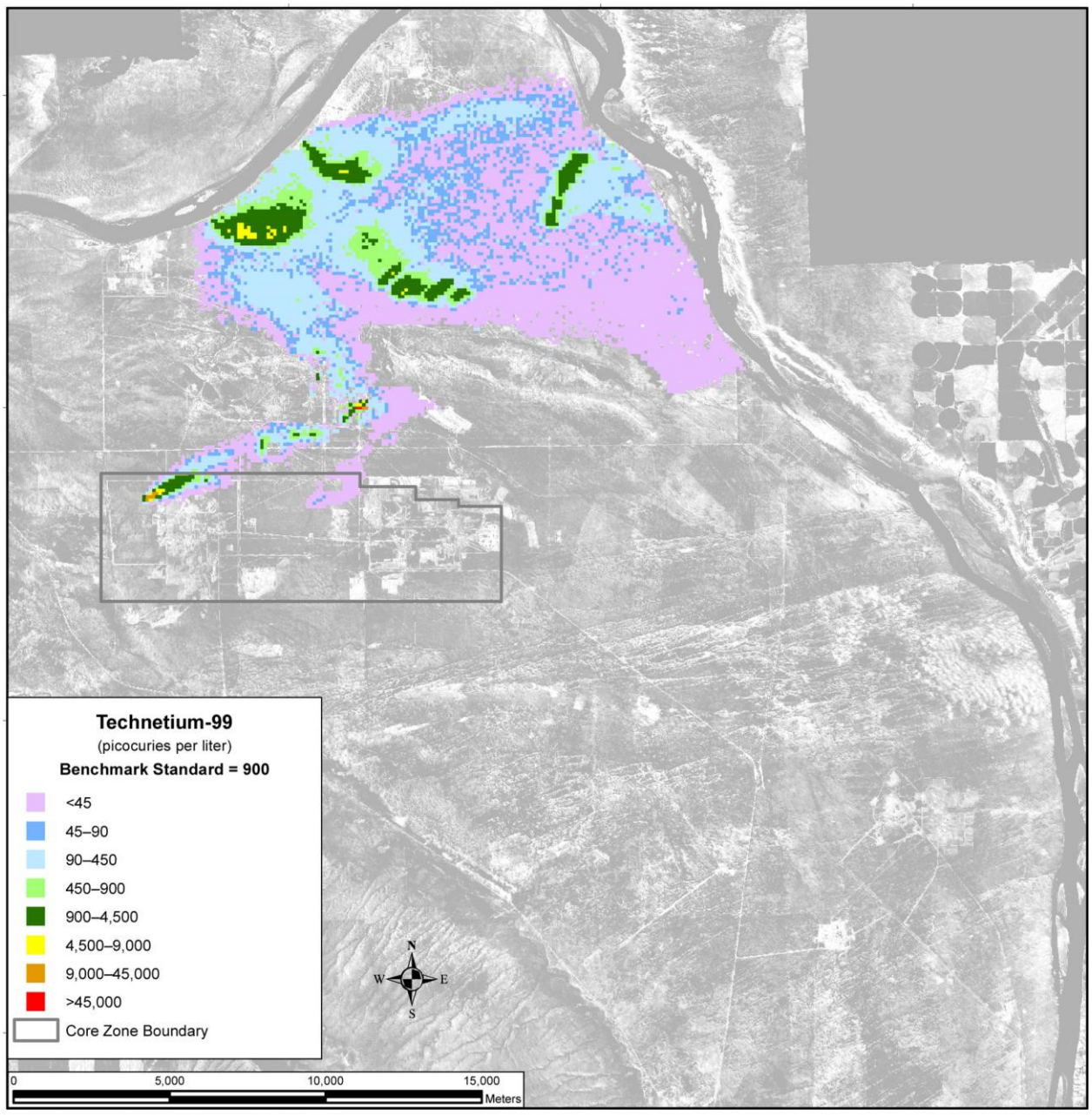
Note: To convert meters to feet, multiply by 3.281.

Figure 5–737. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



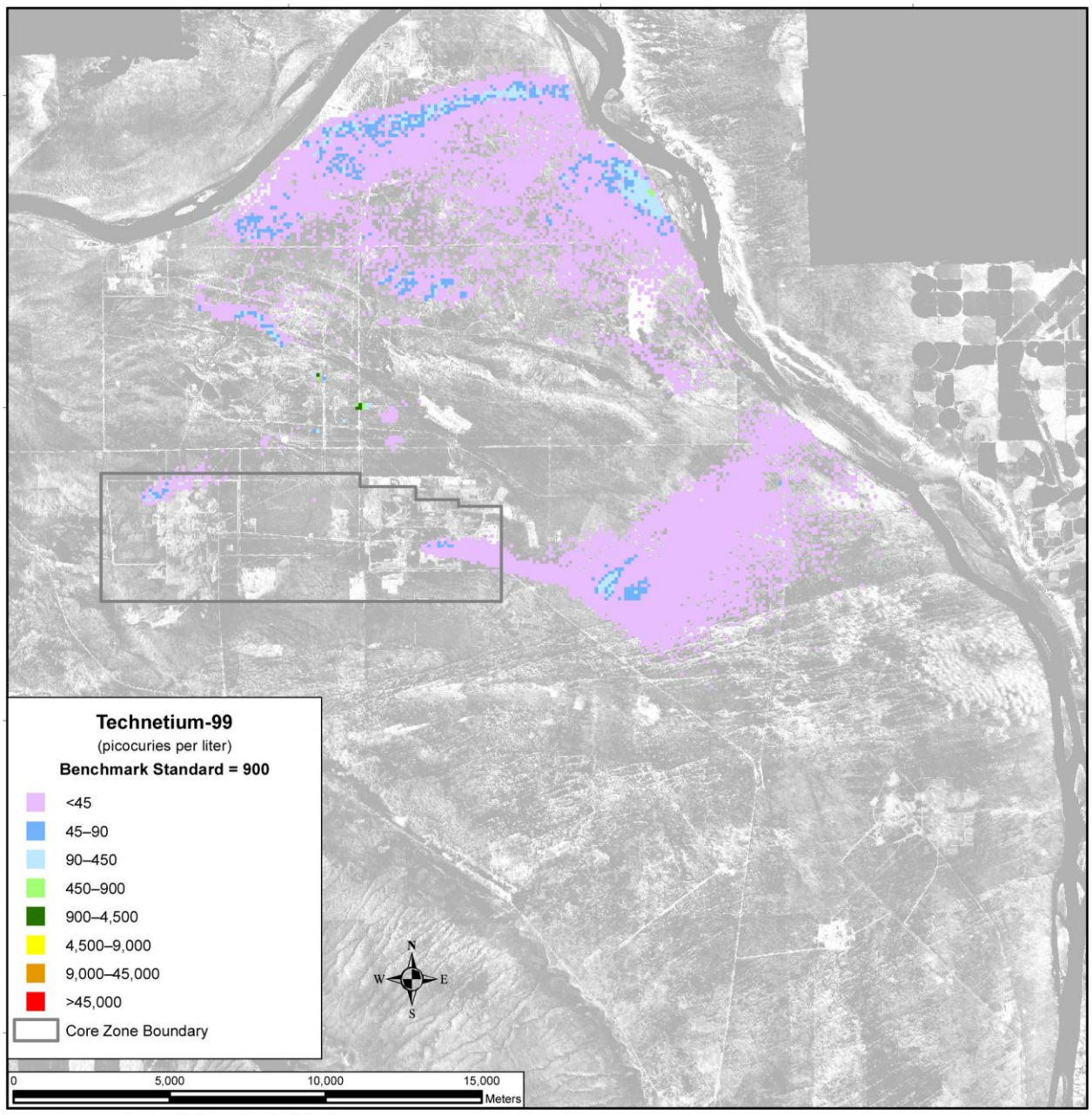
Note: To convert meters to feet, multiply by 3.281.

Figure 5–738. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



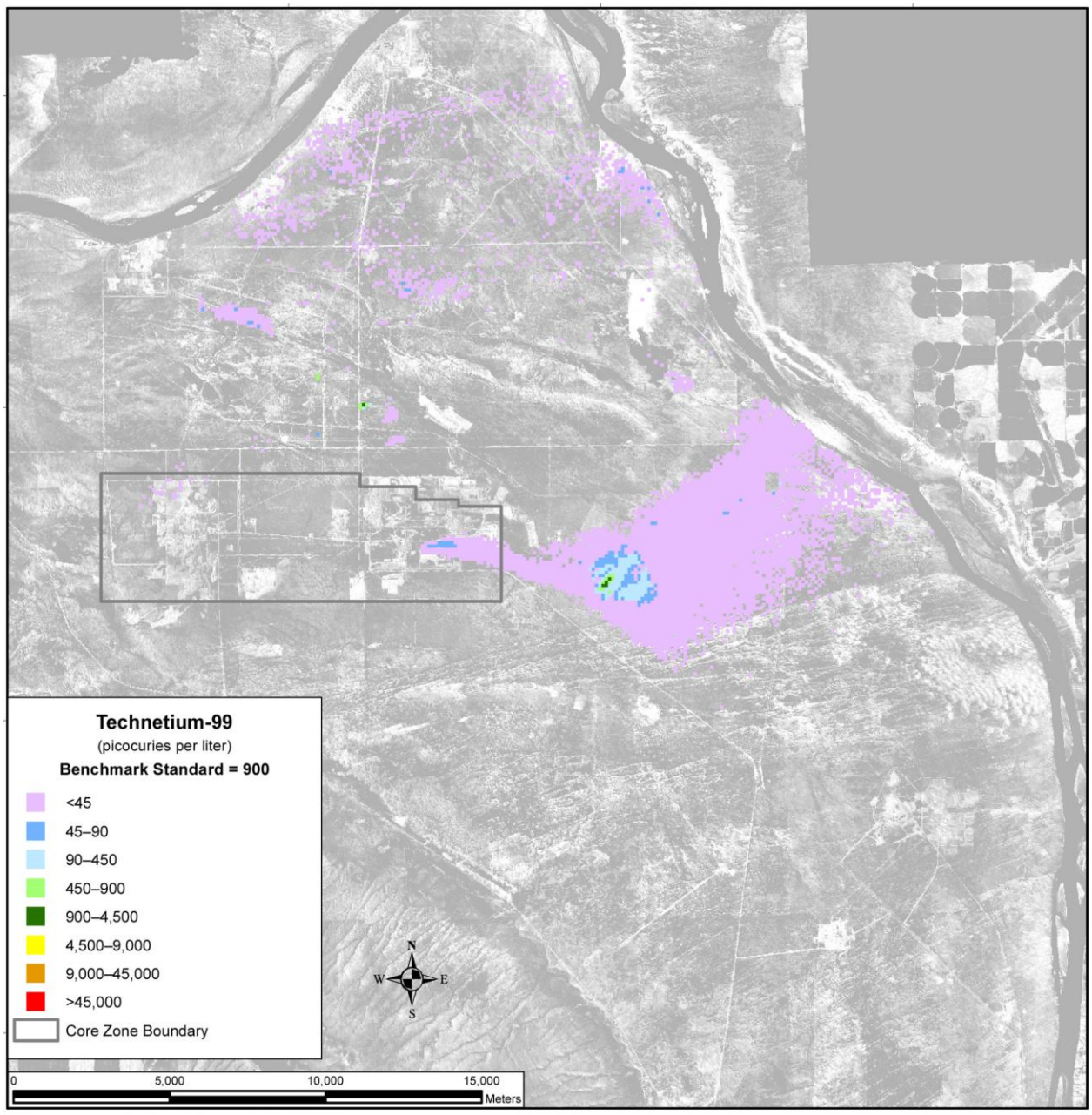
Note: To convert meters to feet, multiply by 3.281.

Figure 5–739. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



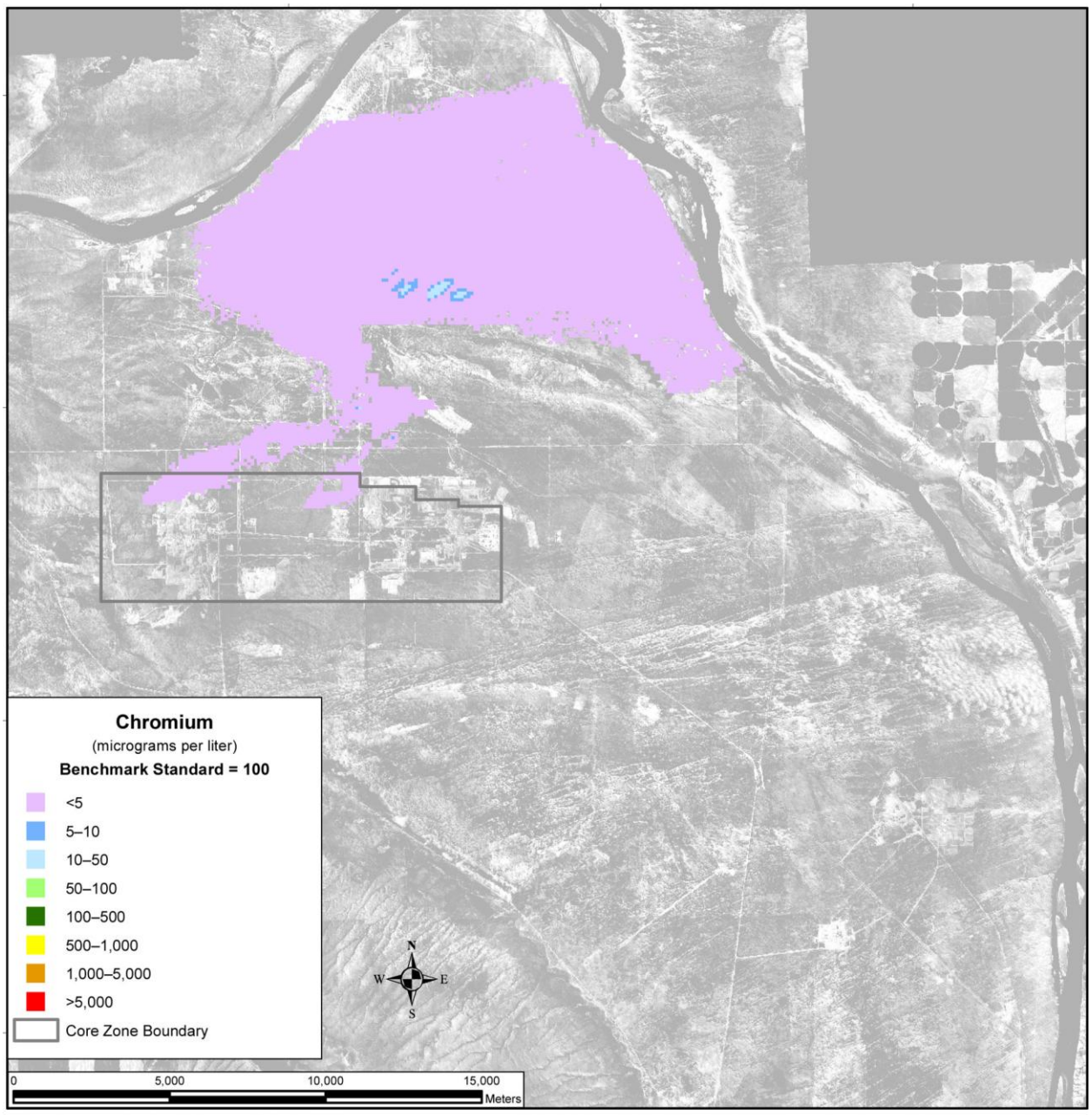
Note: To convert meters to feet, multiply by 3.281.

Figure 5–740. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



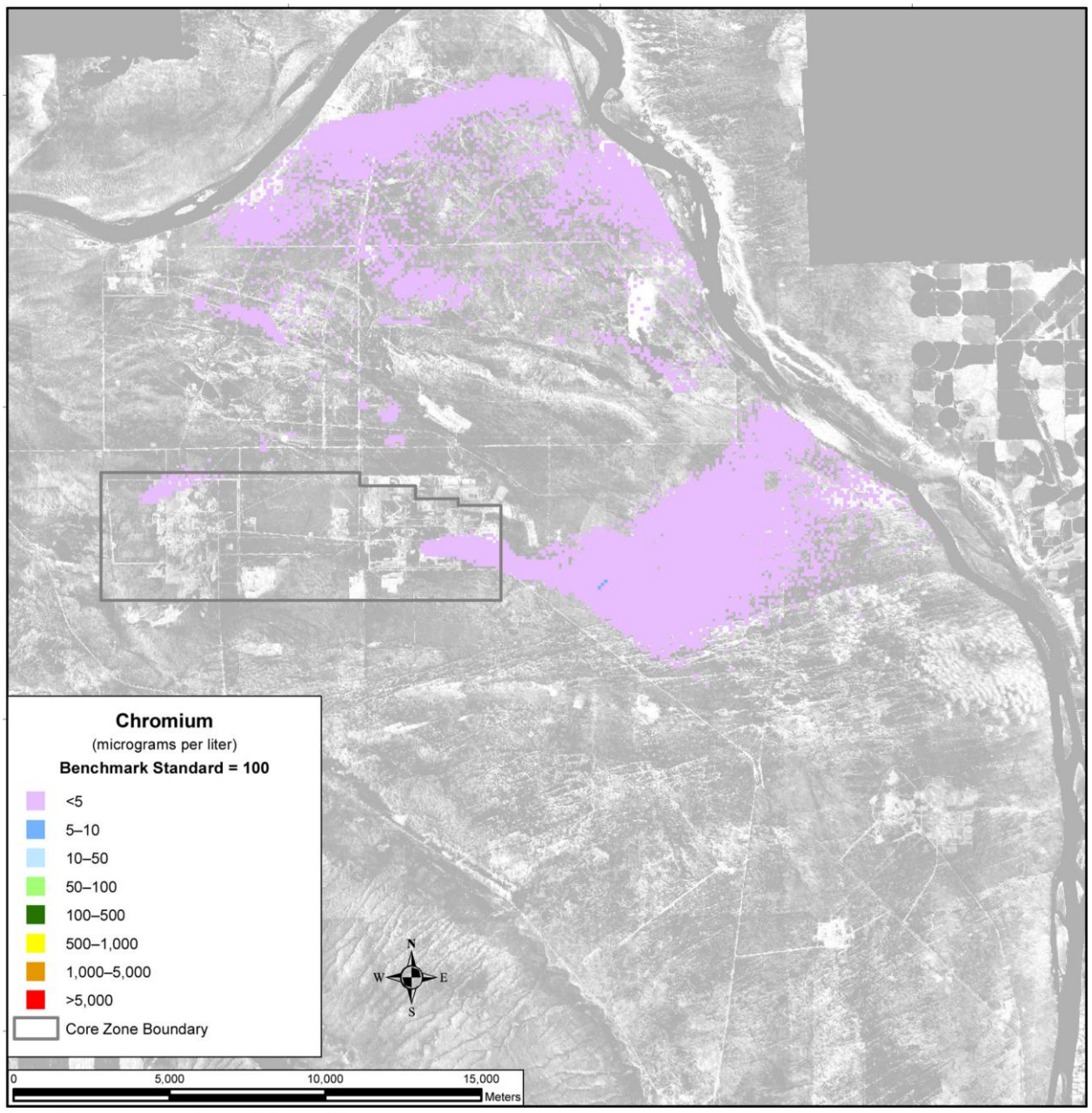
Note: To convert meters to feet, multiply by 3.281.

Figure 5–741. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99, Concentration, Calendar Year 11,885



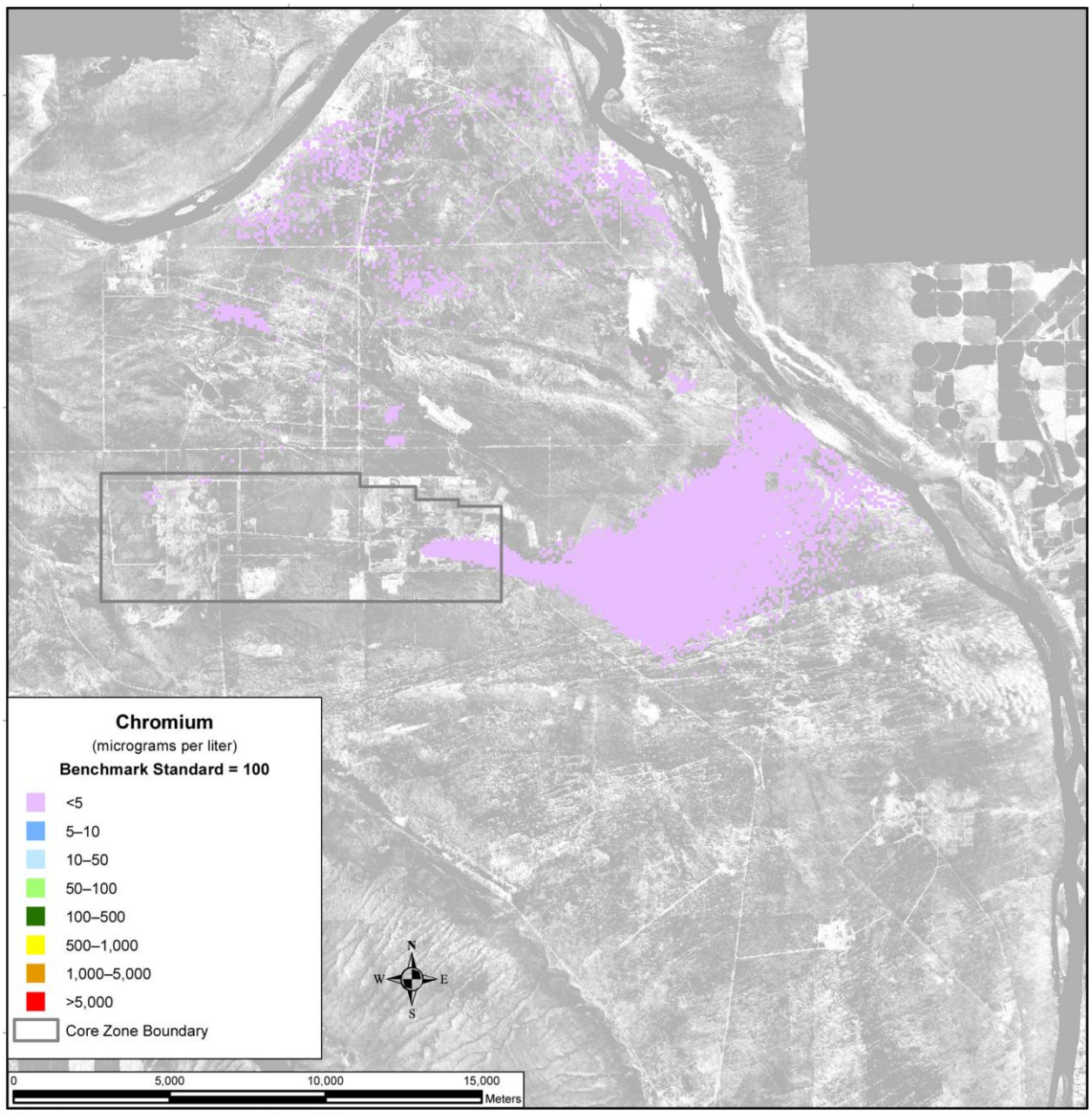
Note: To convert meters to feet, multiply by 3.281.

Figure 5–742. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



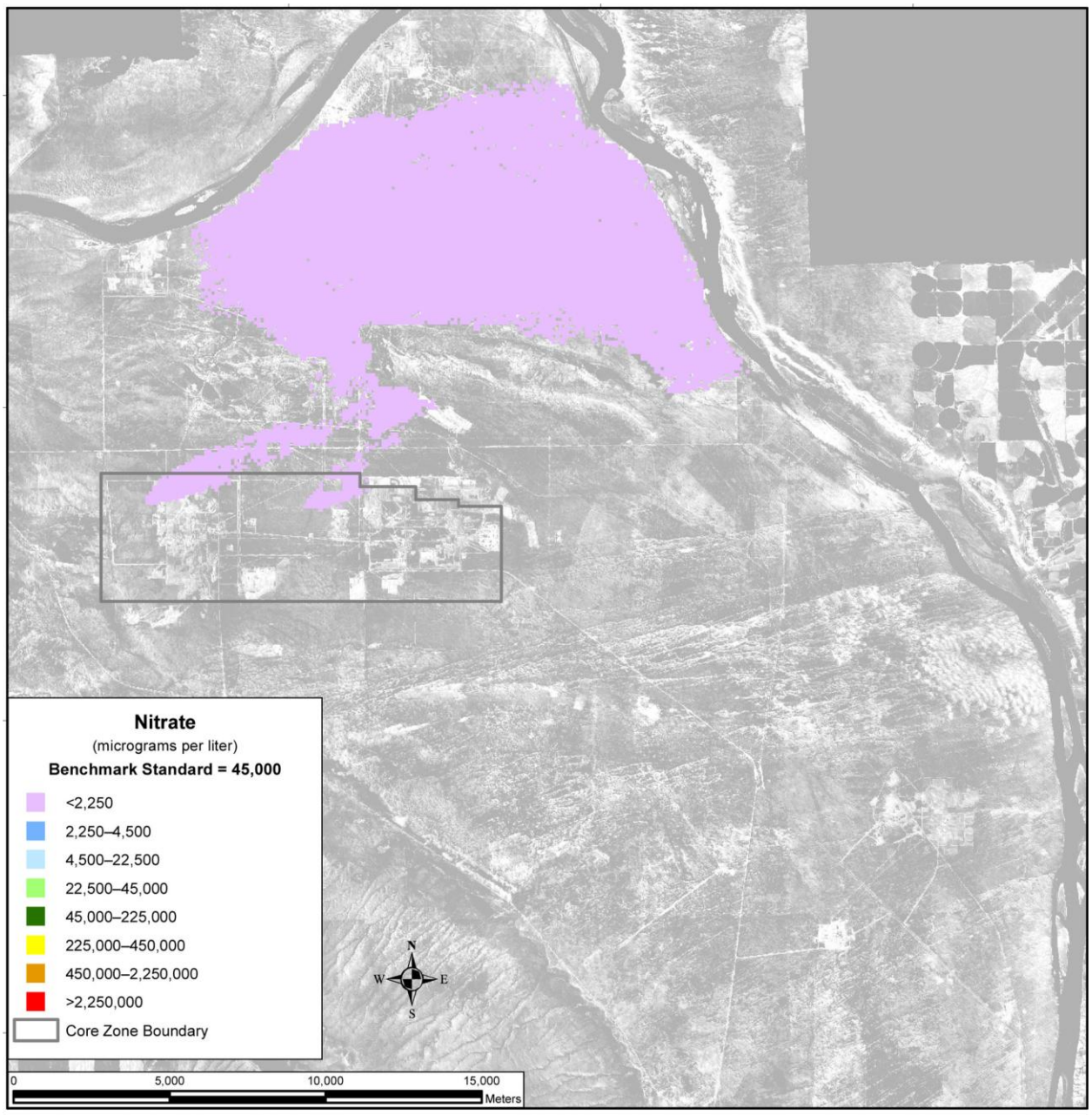
Note: To convert meters to feet, multiply by 3.281.

Figure 5–743. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



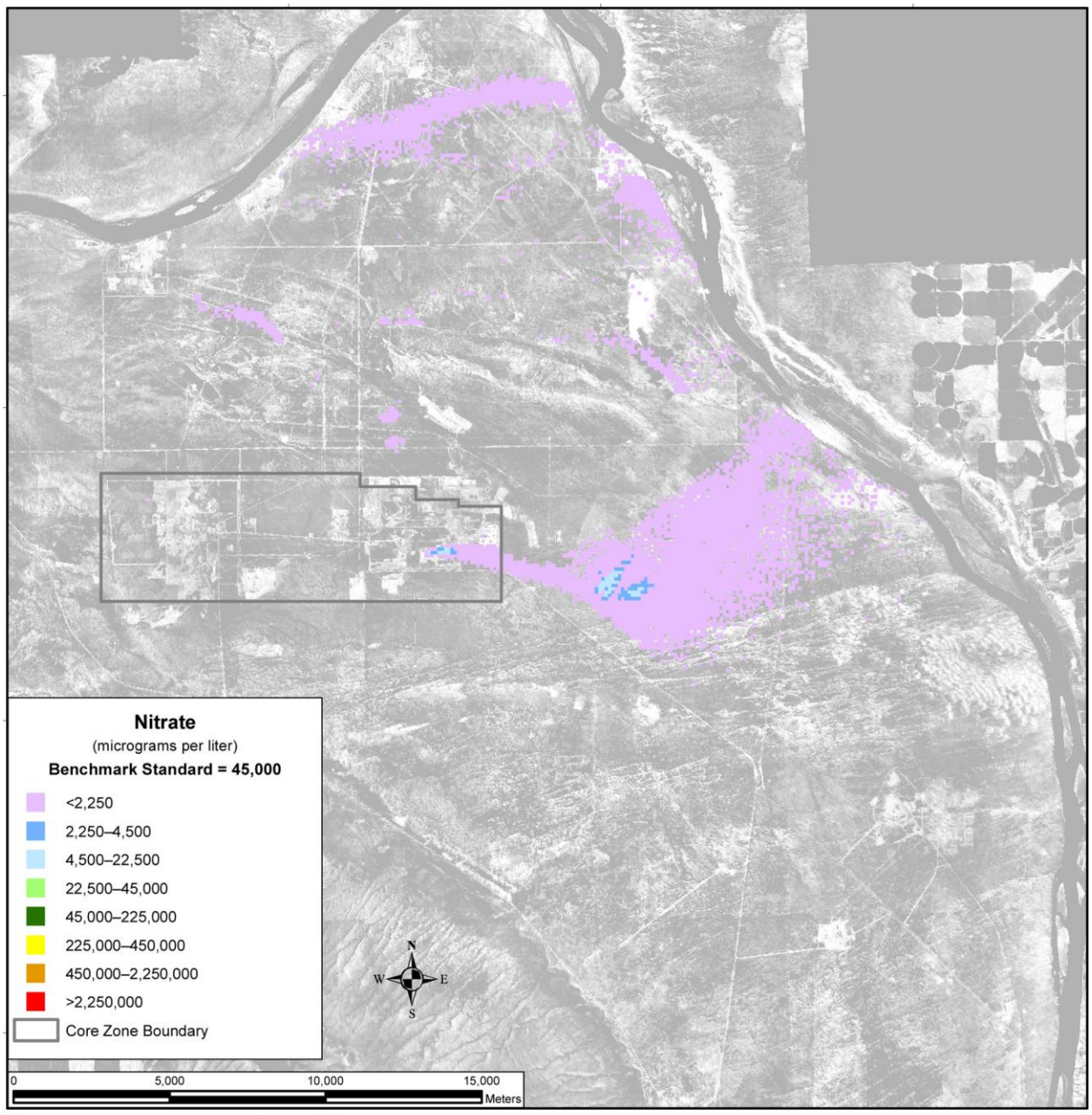
Note: To convert meters to feet, multiply by 3.281.

Figure 5–744. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



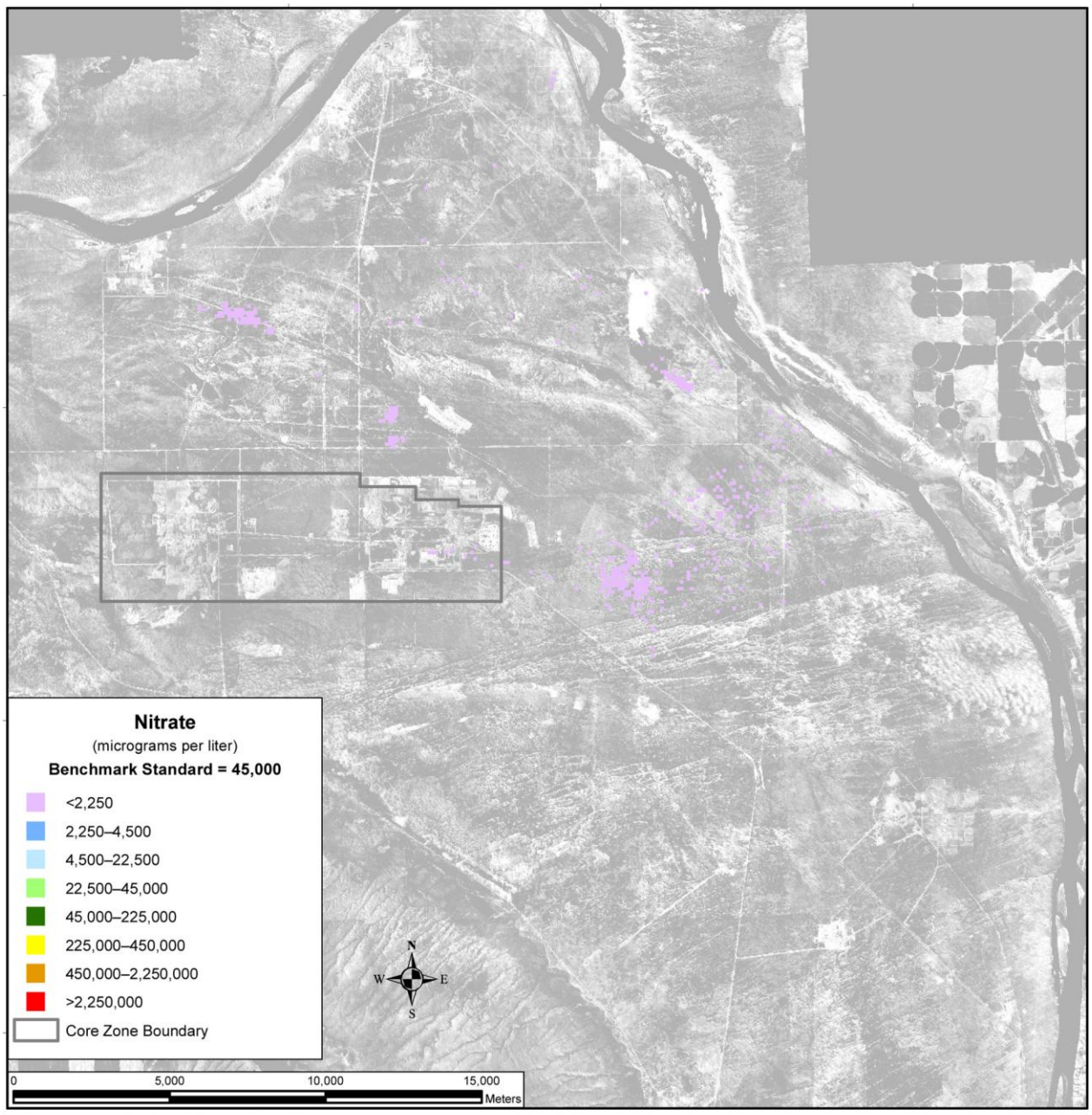
Note: To convert meters to feet, multiply by 3.281.

Figure 5–745. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–746. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–747. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in general, the inventories of the conservative tracers remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For iodine-129 and technetium-99, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentrations at the Columbia River nearshore are about one to two orders of magnitude lower. The intensities and areas of these groundwater plumes peak between CYs 3890 and 7140. Concentrations of

chromium and nitrate never exceed their respective benchmark concentrations at the Core Zone Boundary or Columbia River nearshore.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species do not exceed the benchmark at the Core Zone Boundary or Columbia River nearshore.

5.3.1.3.1.2 Disposal Group 1, Subgroup 1-B

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3A and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW, ILAW glass, and bulk vitrification glass.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary

during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Five subtotals are plotted in Figures 5–748 through 5–753, representing releases from IDF-East, which include ILAW glass, bulk vitrification glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

Figure 5–748 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–749, the chemical hazard drivers. For bulk vitrification castable refractory, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 is bulk vitrification glass; of iodine-129, ETF-generated secondary waste. The predominant source of chromium is tank closure secondary waste, while the predominant source of nitrate is ETF-generated secondary waste. Boron and fluoride are not released from IDF-East.

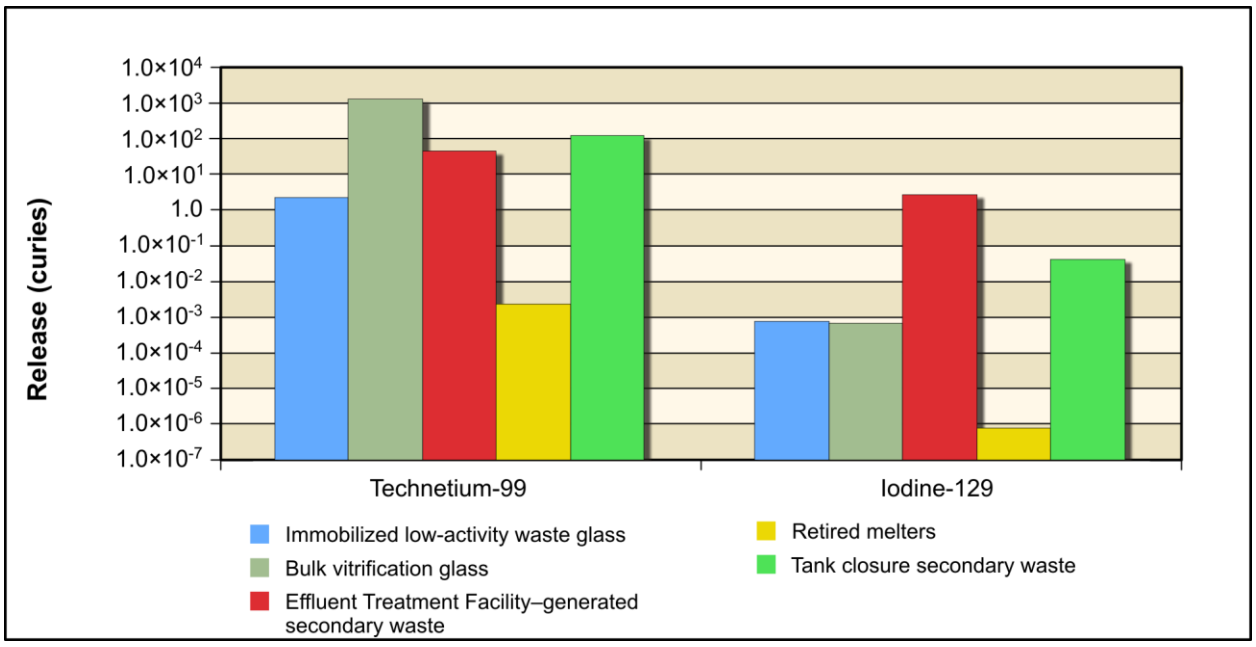


Figure 5–748. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–750 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–751, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99,

chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 91 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

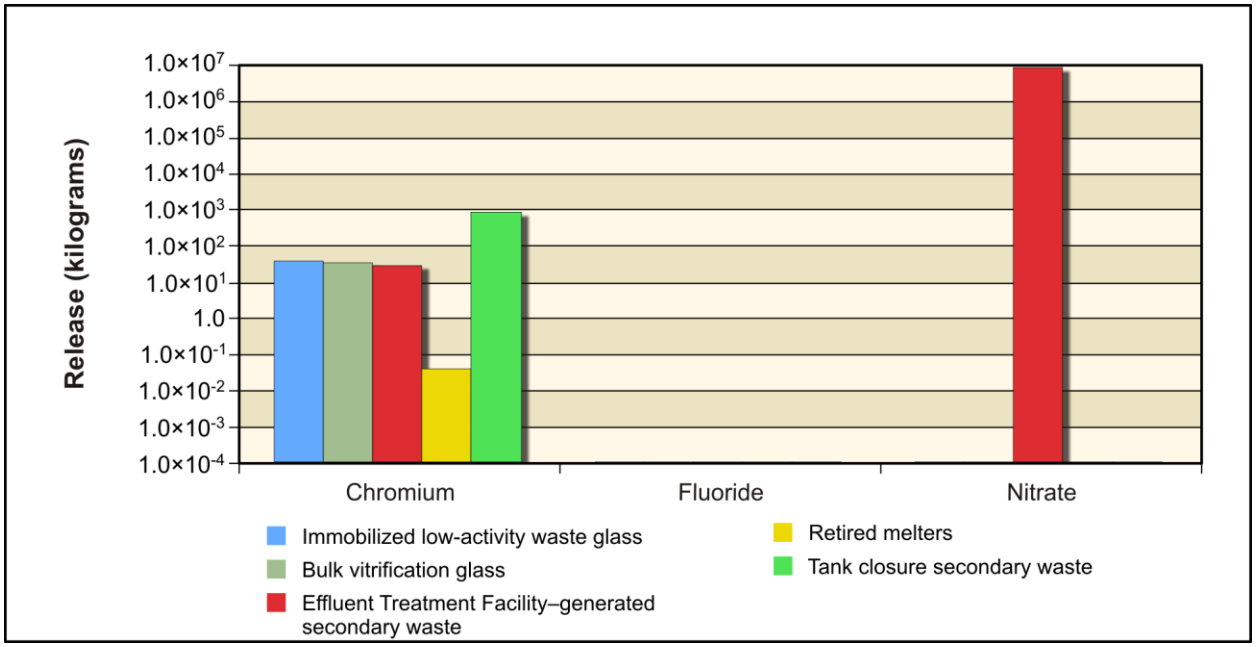


Figure 5–749. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

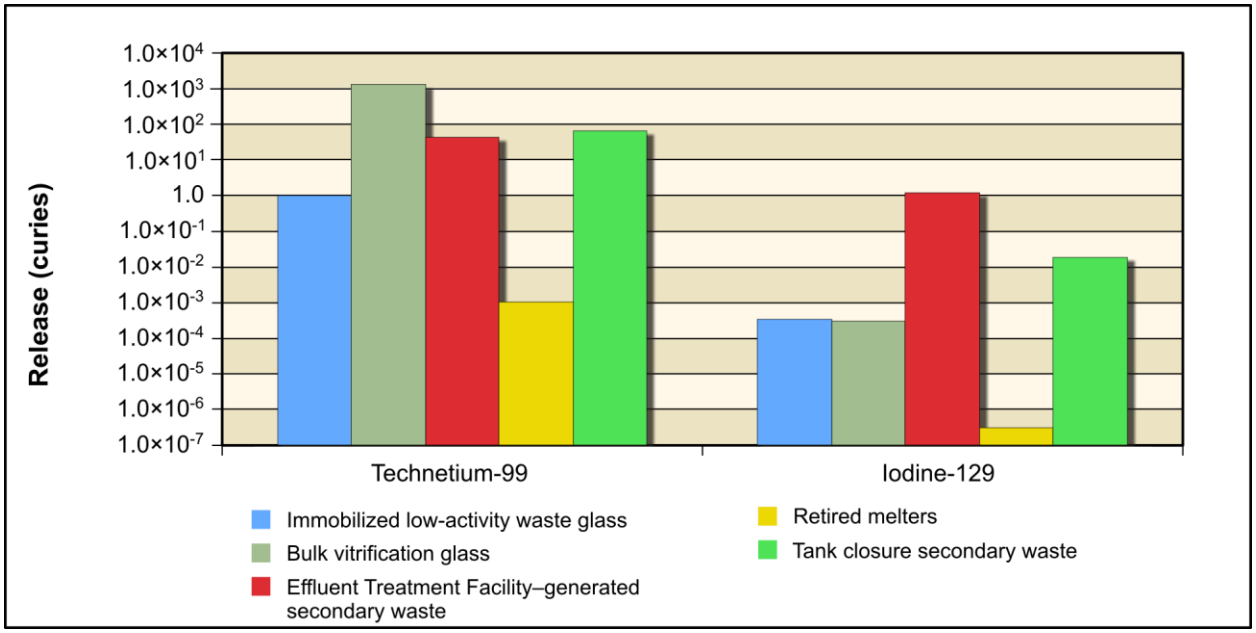


Figure 5–750. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

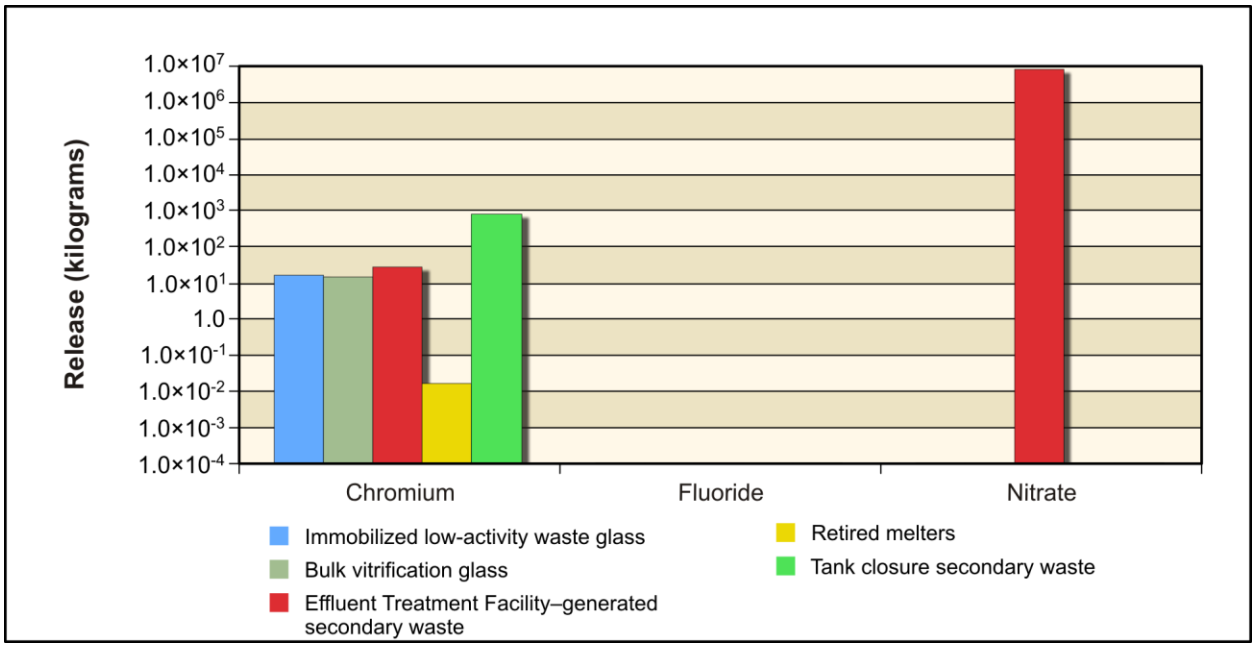


Figure 5–751. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–752 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–753, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclide amount (curies) released to the groundwater during the period of analysis reaches the river; approximately 100 percent of the chemical quantity (kilograms) reaches the river.

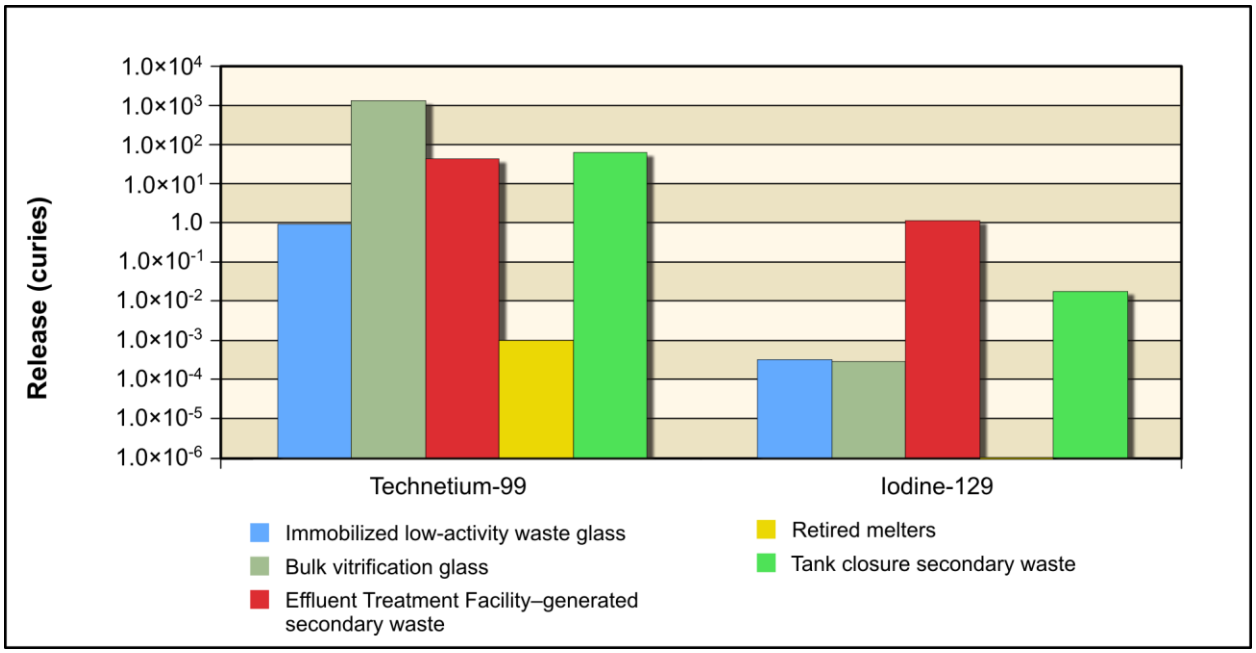


Figure 5–752. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

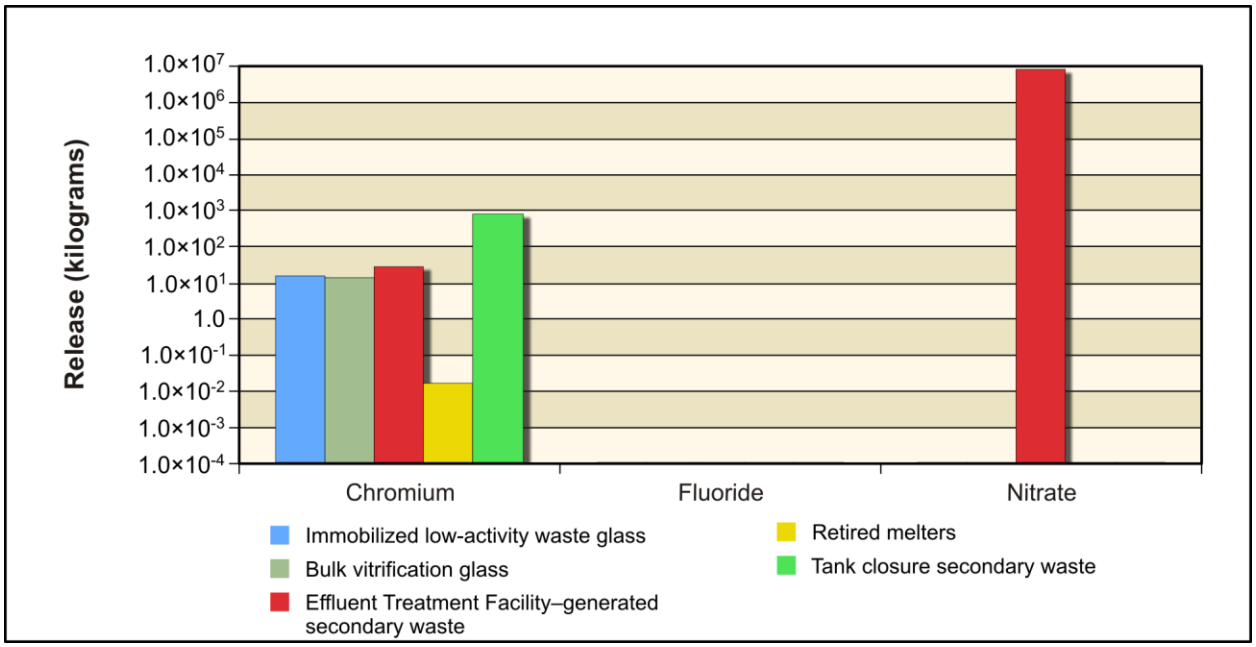


Figure 5–753. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–754 through 5–759, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–754 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–755, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. The predominant source of chromium, nitrate, and fluoride is waste management secondary waste and onsite waste.

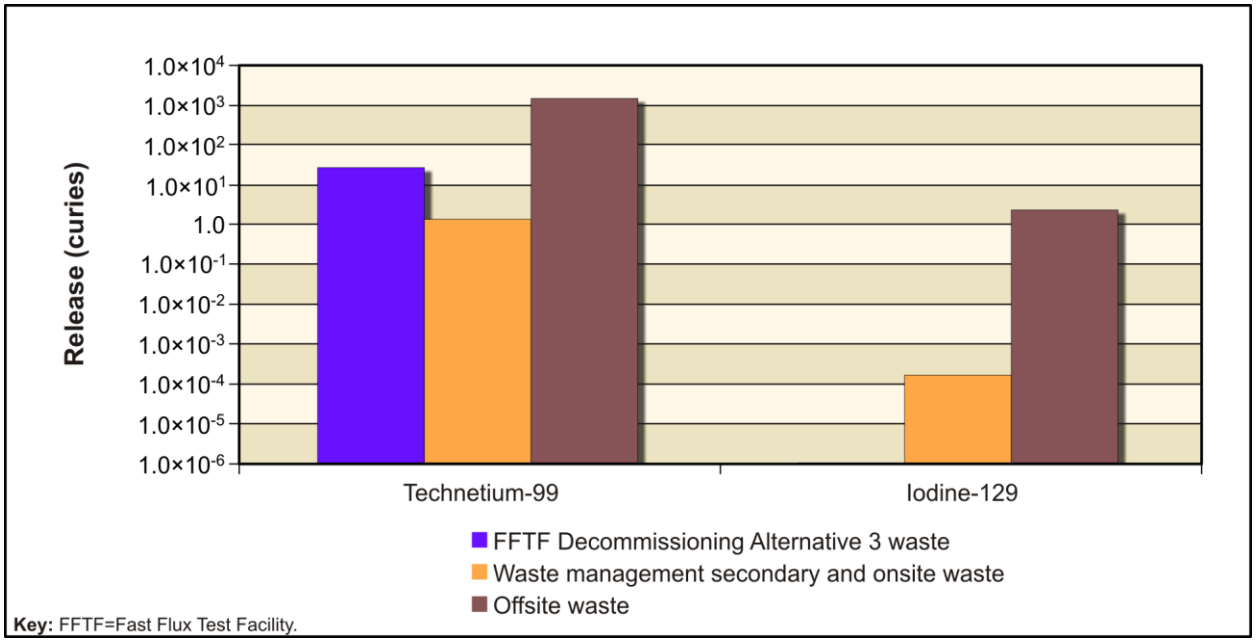


Figure 5–754. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

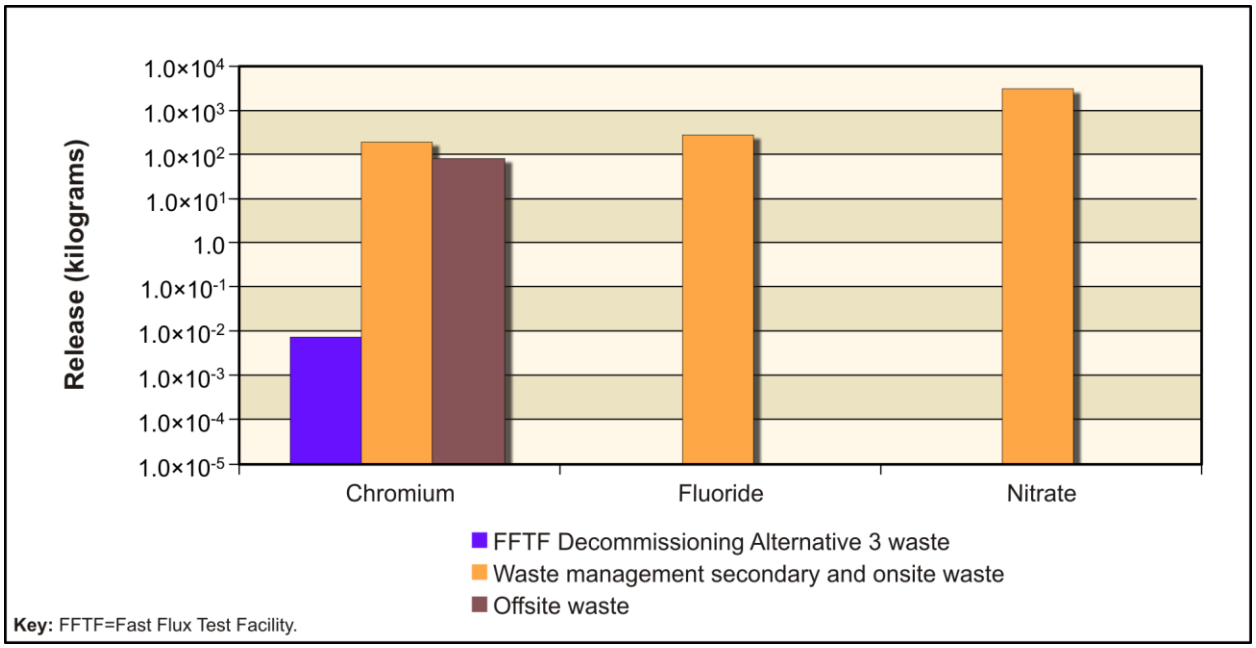


Figure 5–755. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–756 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–757, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, nitrate, and fluoride, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 97 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

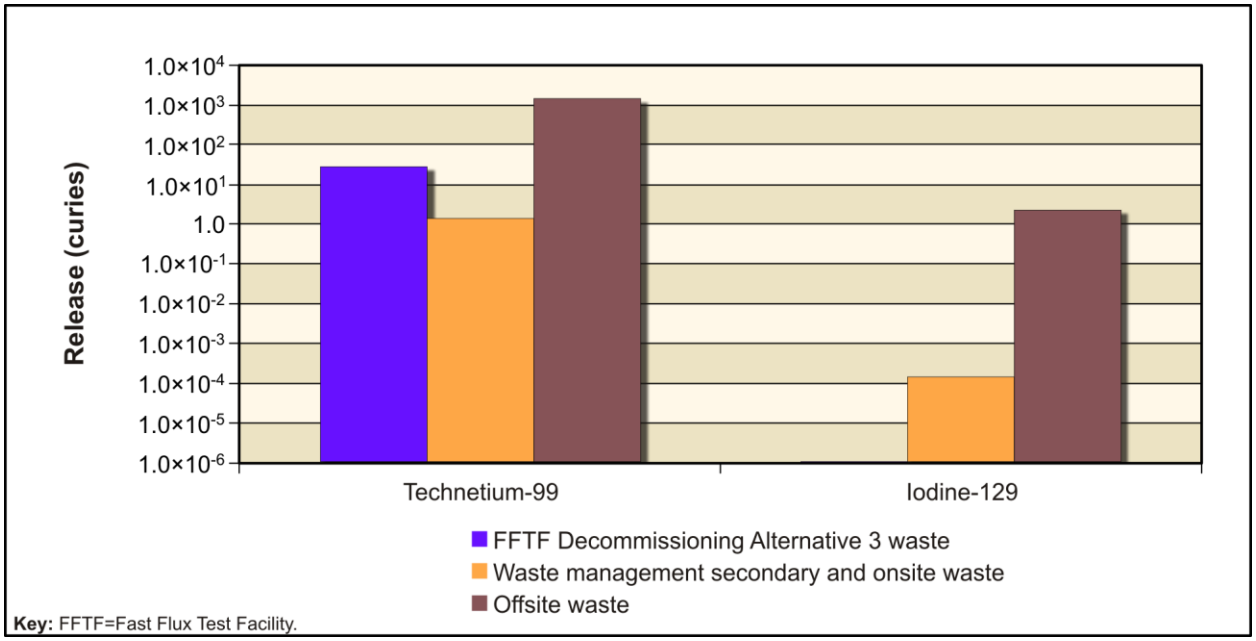


Figure 5–756. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

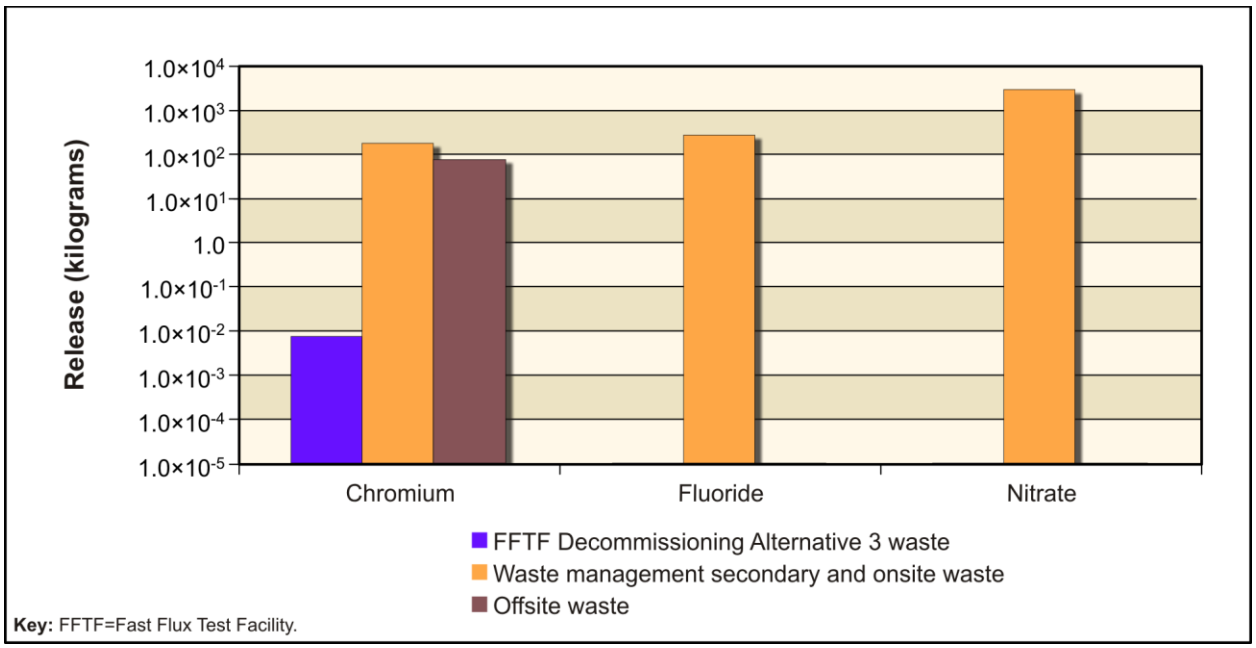


Figure 5–757. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–758 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–759, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, nitrate, and fluoride, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; approximately 100 percent of the chemical quantity (kilograms) reaches the river.

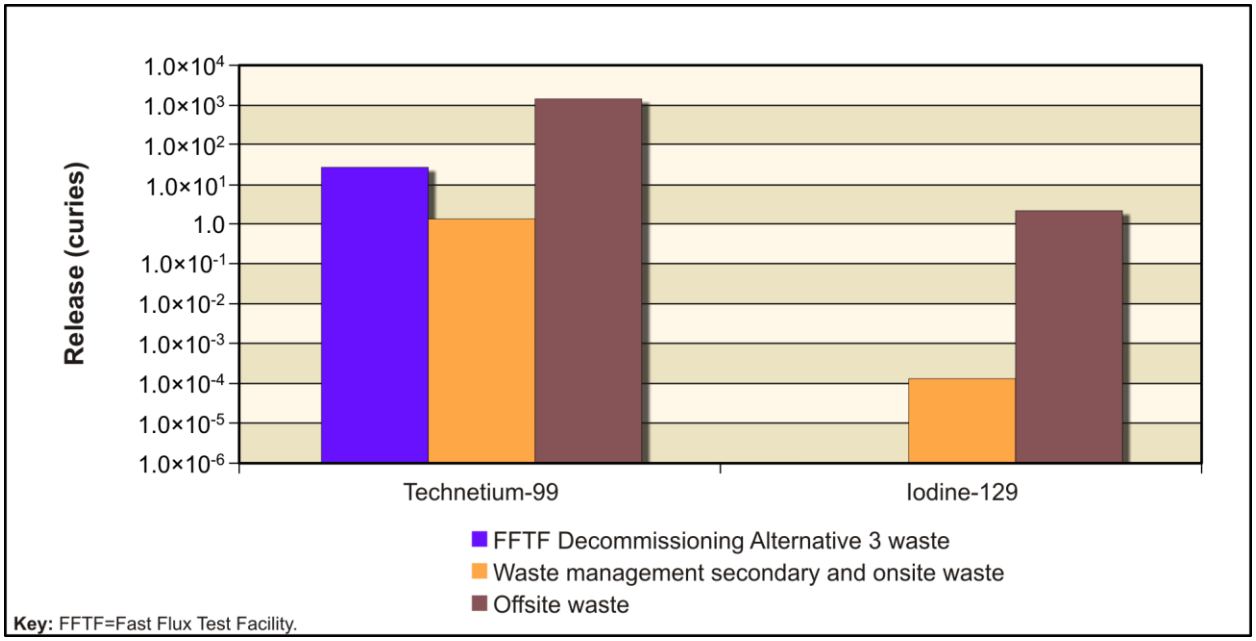


Figure 5–758. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

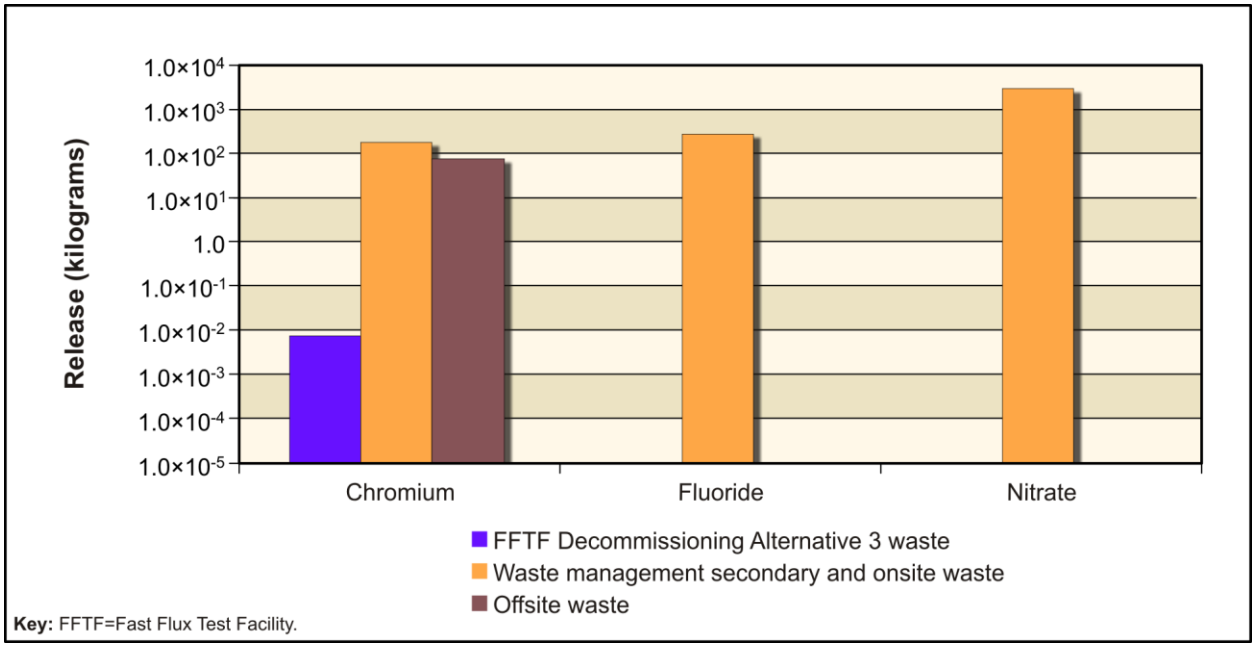


Figure 5–759. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–760 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–761, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). Fluoride is not released from the RPPDF.

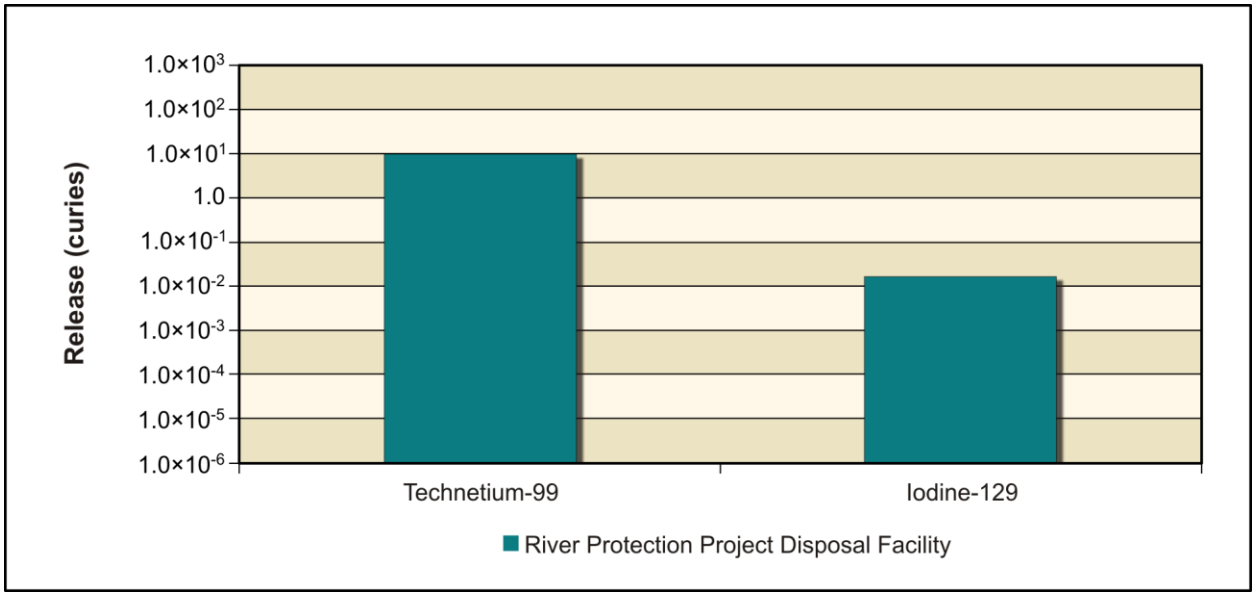


Figure 5–760. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

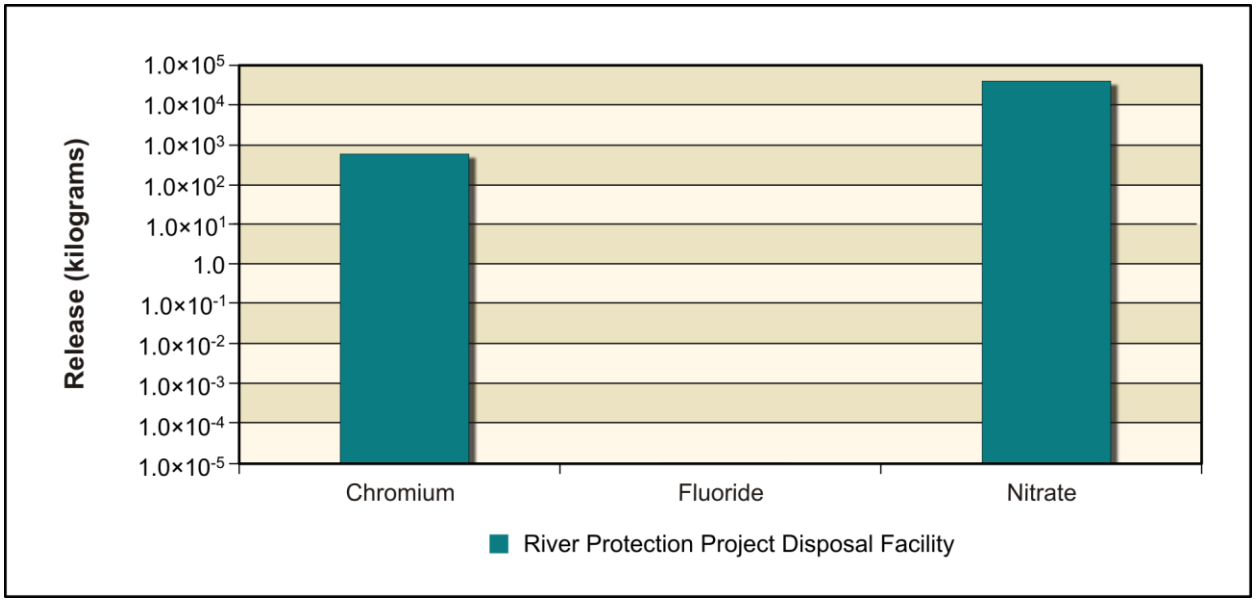


Figure 5–761. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–762 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–763, the chemical hazard drivers. In addition to the inventory considerations discussed in

the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

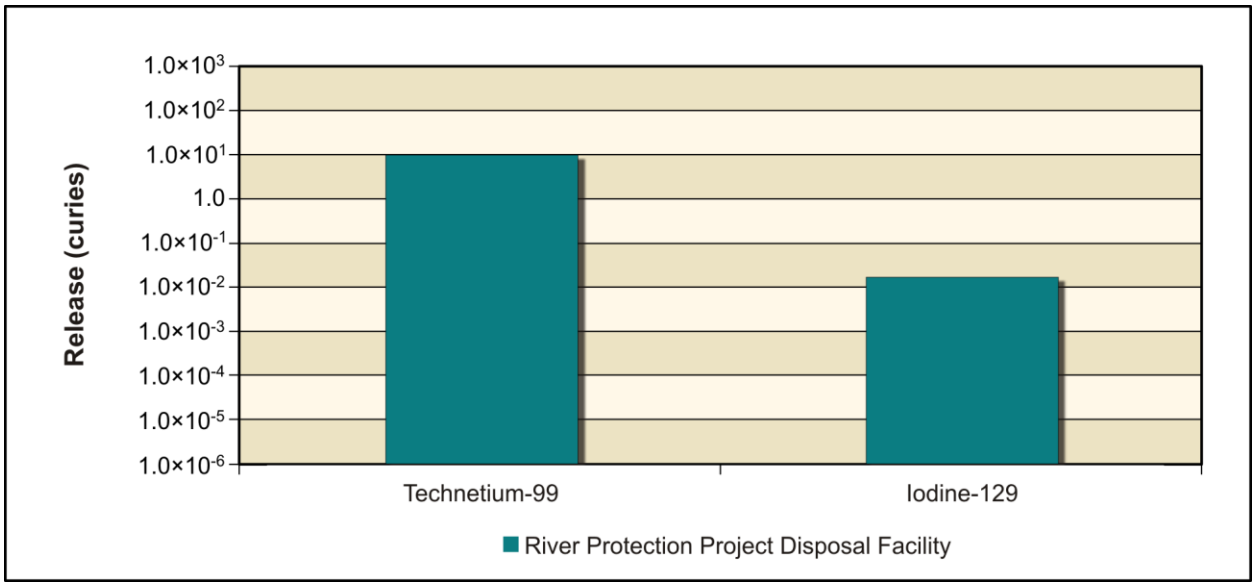


Figure 5–762. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

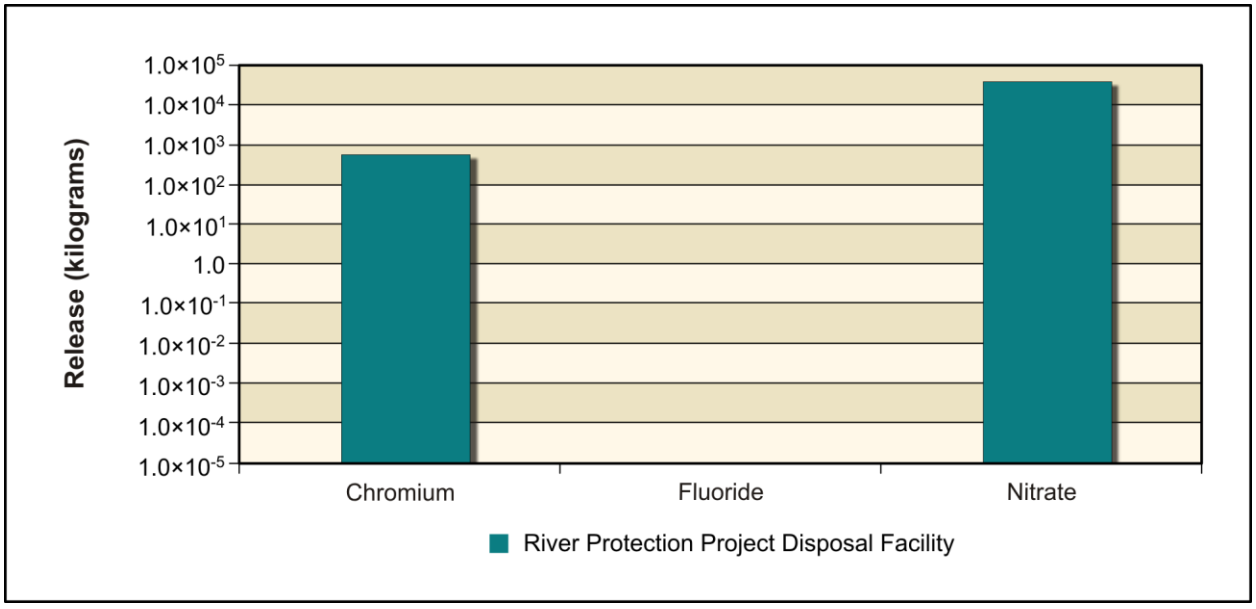


Figure 5–763. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–764 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–765, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater.

Overall, 99 percent of the radionuclide amount (curies) released to the groundwater during the period of analysis reaches the river; 99 percent of the chemical quantity (kilograms) reaches the river.

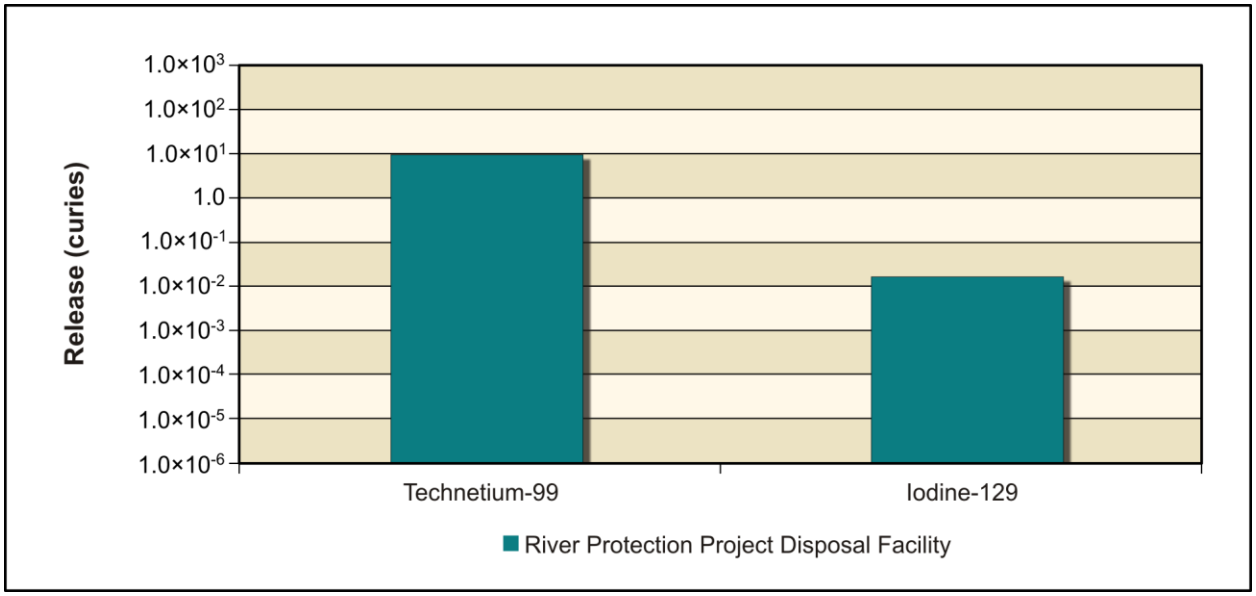


Figure 5–764. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

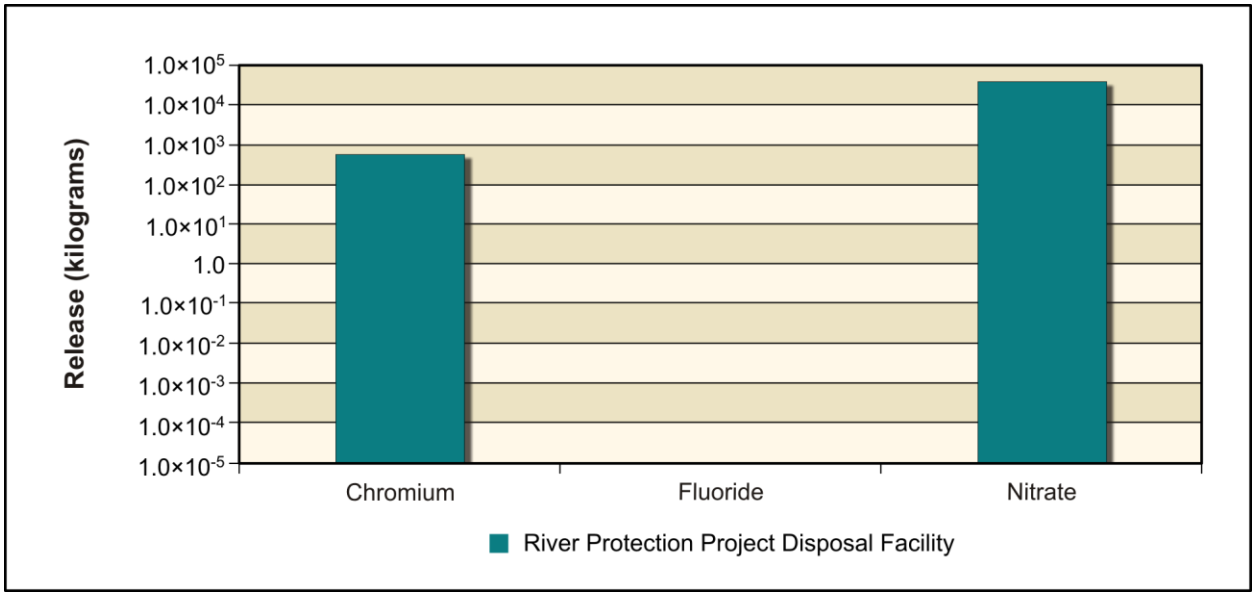


Figure 5–765. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–766 through 5–770). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–107 lists the

maximum concentrations of the COPCs in the peak year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Exceedances of the benchmarks occur only for technetium-99 and iodine-129 at IDF-East, IDF-West, the Core Zone Boundary, and the Columbia River nearshore.

Table 5–107. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**1,430**	**13,200**	42	**1,370**	**1,670**	900
	(7629)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	**1.1**	**20.6**	0.1	**2.1**	**2.4**	1
	(9967)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	1	1	3	1	0	100
	(8691)	(3813)	(3740)	(3846)	(4481)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	10,300	7	180	2,790	2,210	45,000
	(8052)	(3927)	(3670)	(8095)	(7940)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–766 through 5–769 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate, respectively. Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 4800. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6000. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is approximately 1,300 years. In addition, the technetium-99 benchmark concentration is exceeded at the IDF-East barrier late in the simulation, between CY 7000 and CY 8700. Nitrate and chromium do not exceed their benchmark concentrations at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

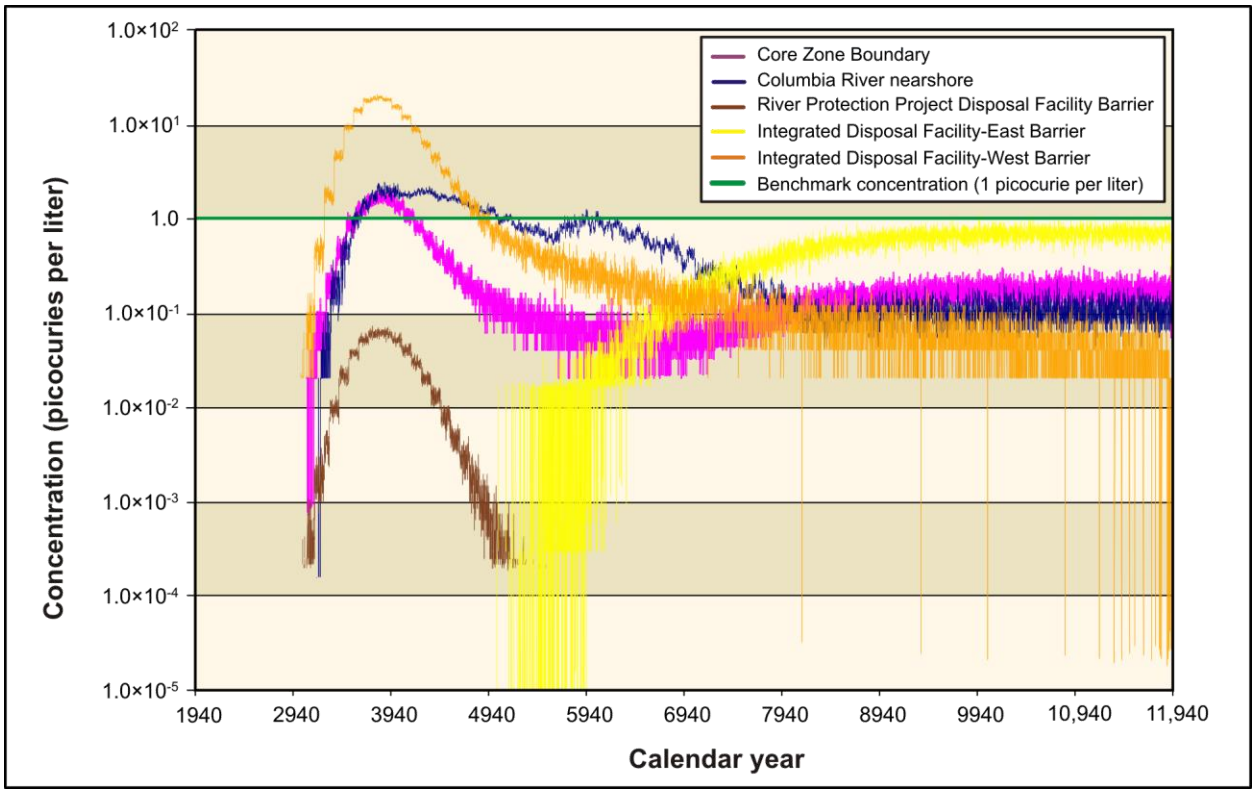


Figure 5–766. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Iodine-129 Concentration Versus Time

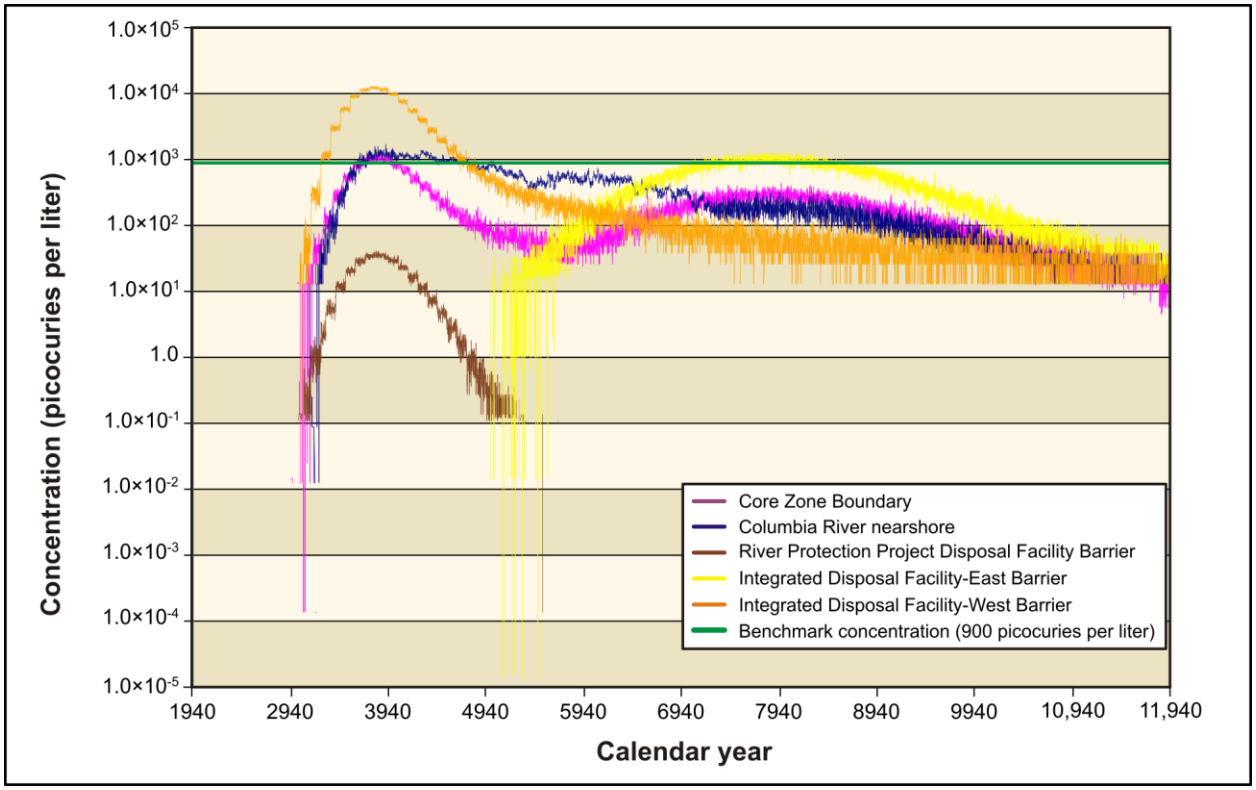


Figure 5–767. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Technetium-99 Concentration Versus Time

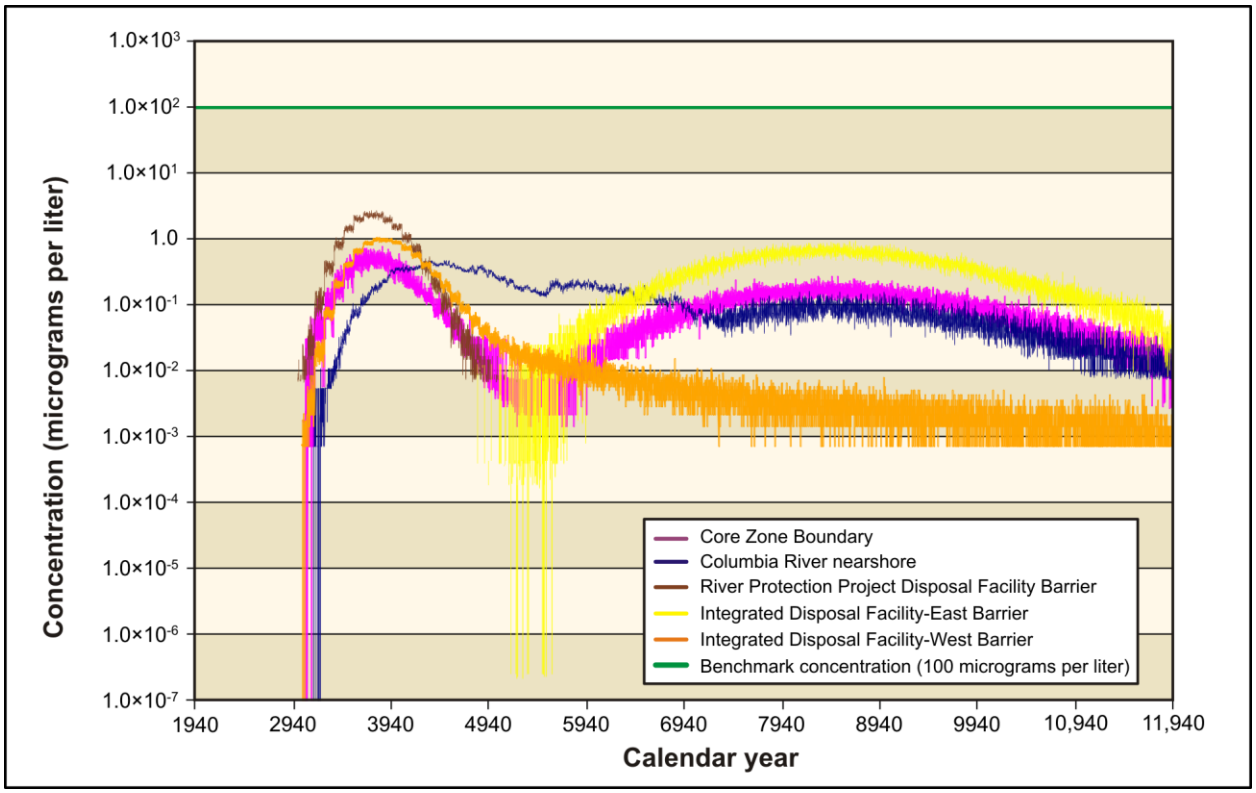


Figure 5–768. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chromium Concentration Versus Time

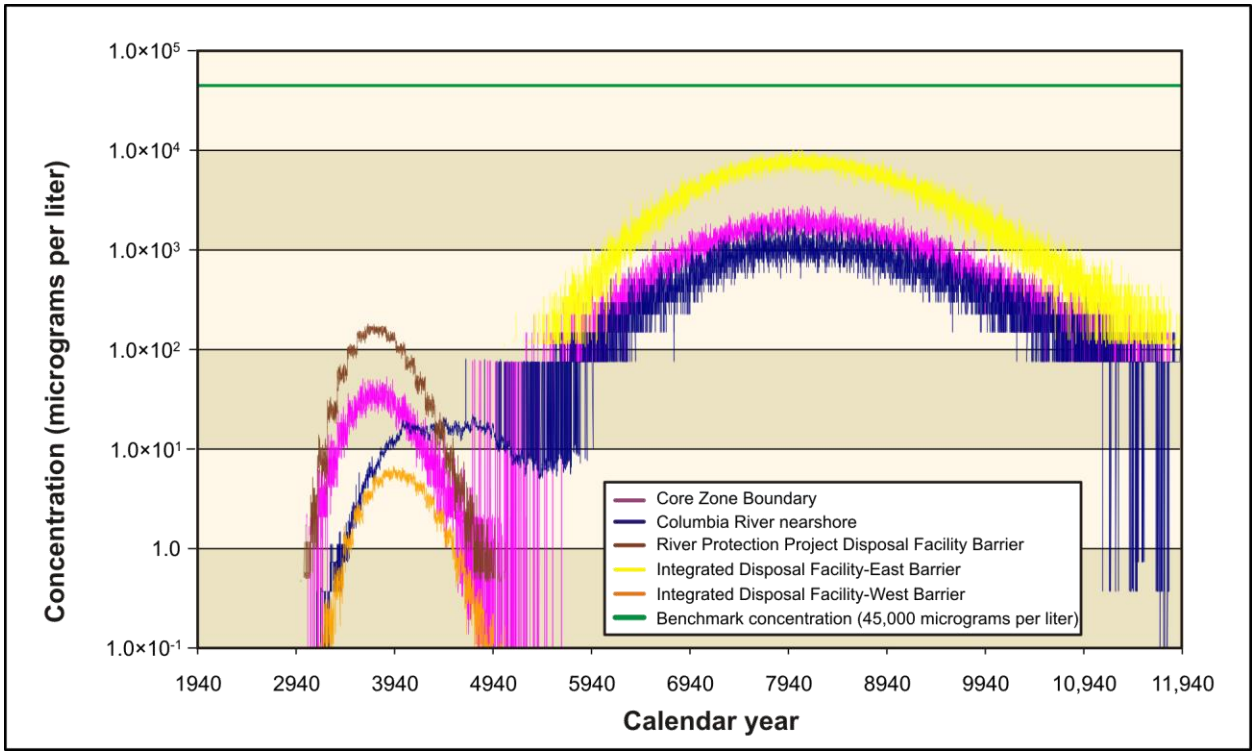


Figure 5–769. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Nitrate Concentration Versus Time

Figure 5–770 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while very minimal, begin to rise at the RPPDF barrier and Core Zone Boundary in approximately CY 10,000, but never get closer than six orders of magnitude of exceeding benchmark concentrations by the end of the period of analysis.

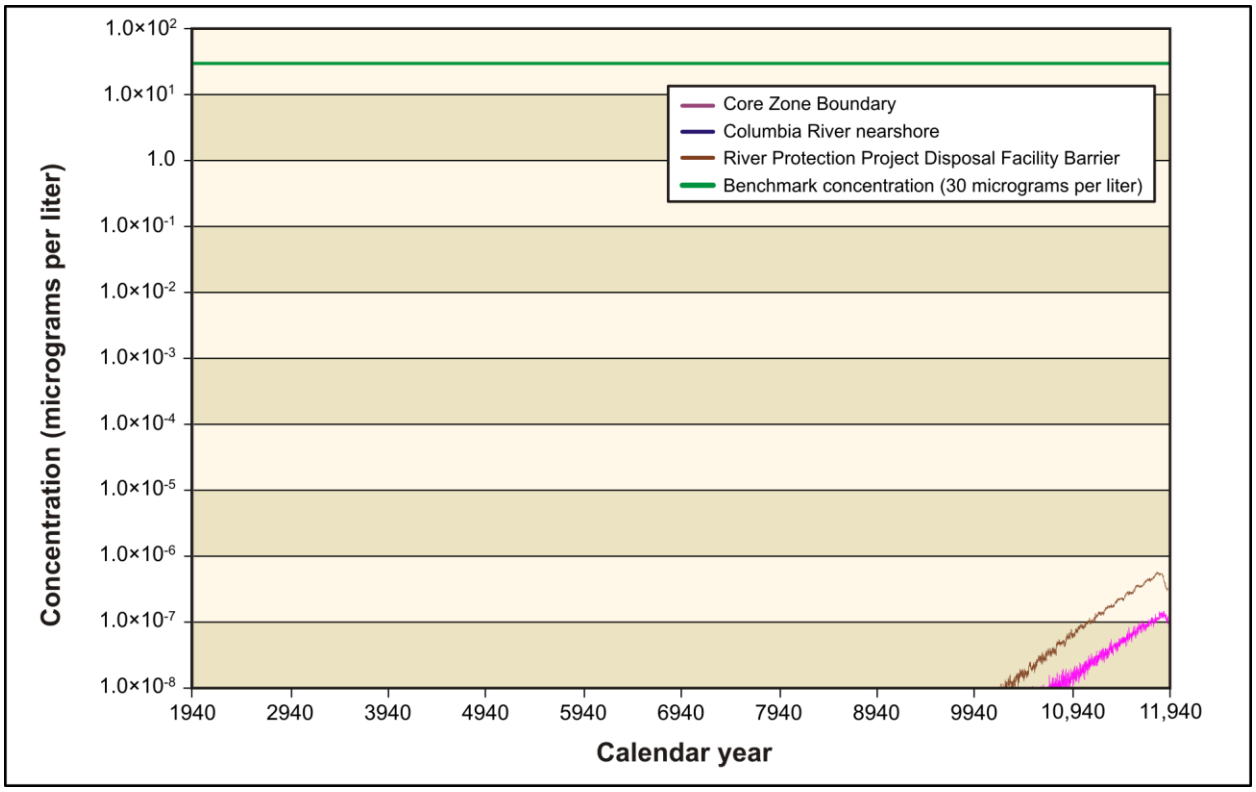


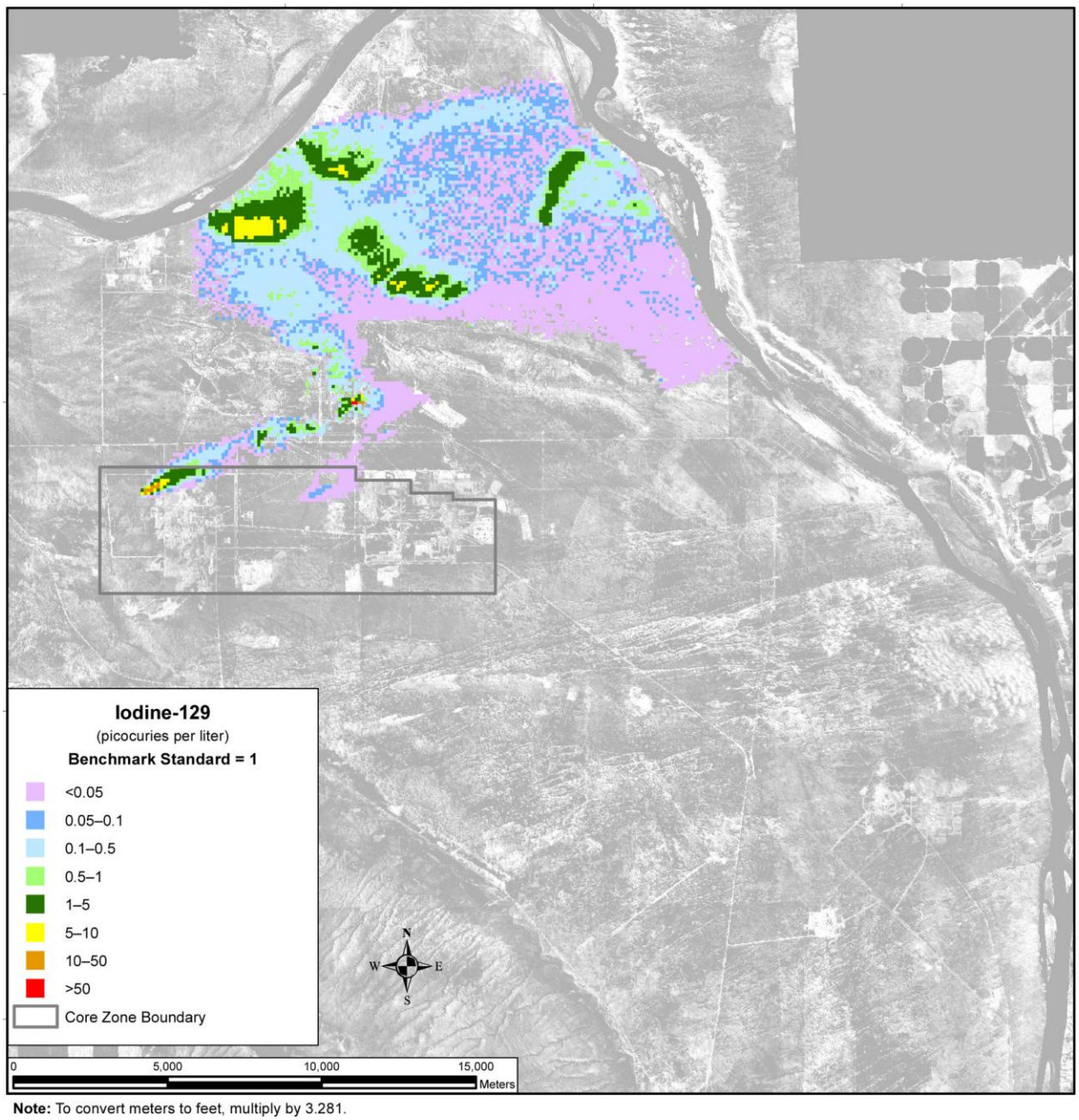
Figure 5–770. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–771 through 5–782). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

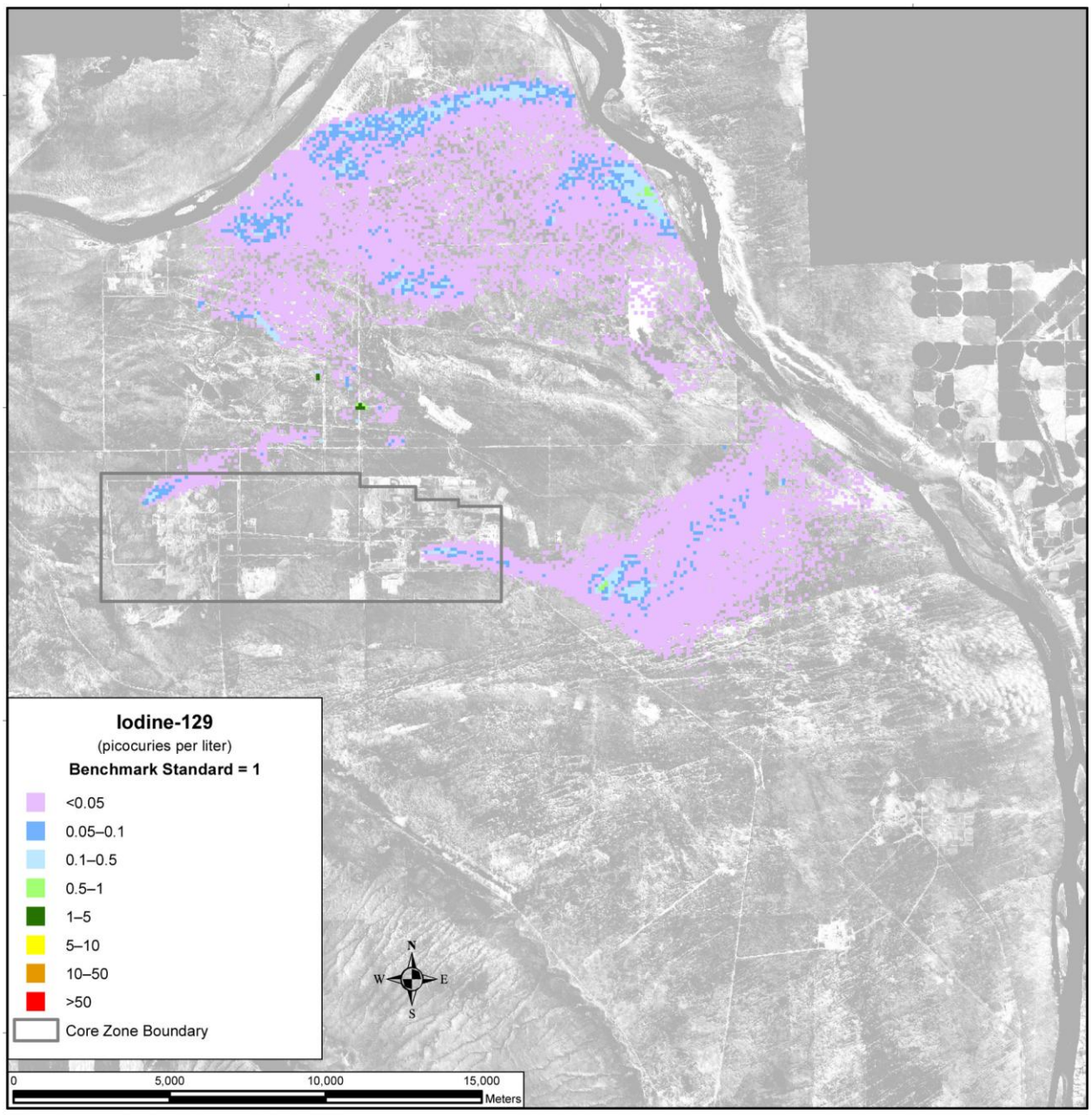
Figure 5–771 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Gap. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–772). Also, by CY 7140, most of the IDF-West and RPPDF plumes continue to move north and reach the Columbia River. By CY 11,885, most of the mass

in the IDF-East plume is still moving east toward the Columbia River, with only small, isolated pockets of concentration exceeding the benchmark (see Figure 5–773). Technetium-99 (see Figures 5–774 through 5–776) shows similar spatial distributions at selected times and exceeds the benchmark concentration at approximately the same time and locations. Chromium (see Figures 5–777 through 5–779) and nitrate (see Figures 5–780 through 5–782) show similar spatial distributions at selected times, but neither exceeds its benchmark concentration. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



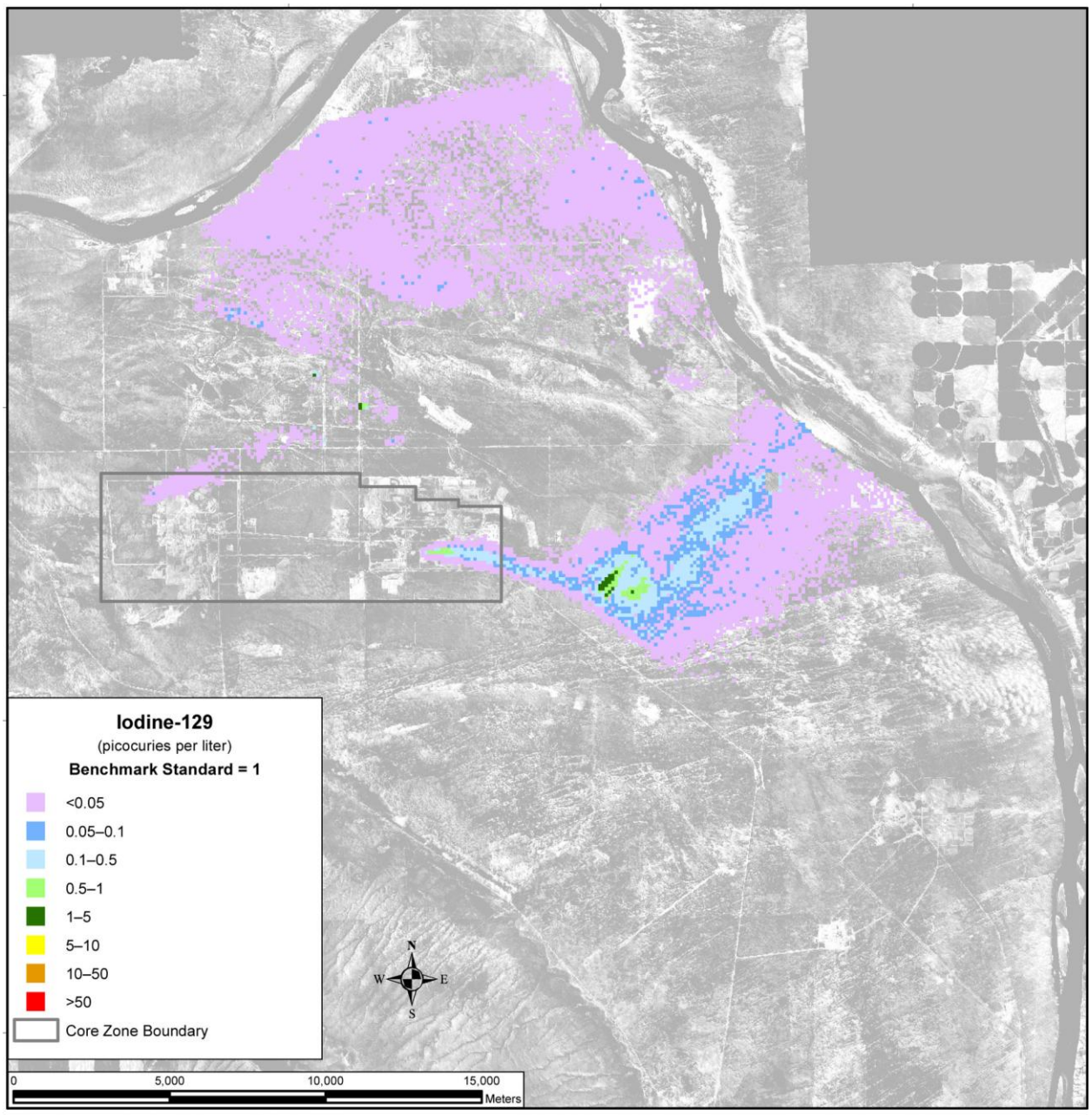
Note: To convert meters to feet, multiply by 3.281.

Figure 5–771. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



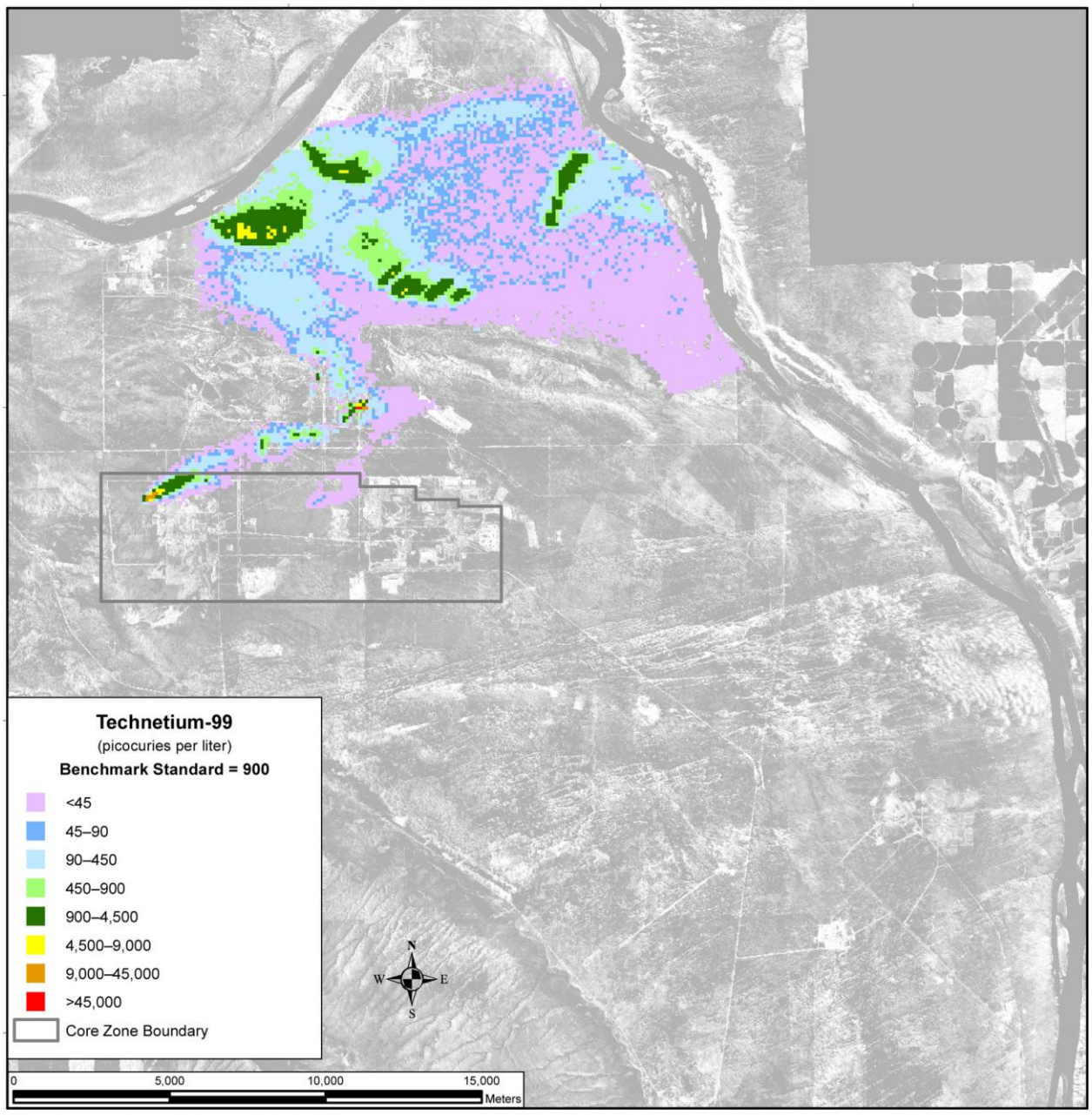
Note: To convert meters to feet, multiply by 3.281.

Figure 5–772. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



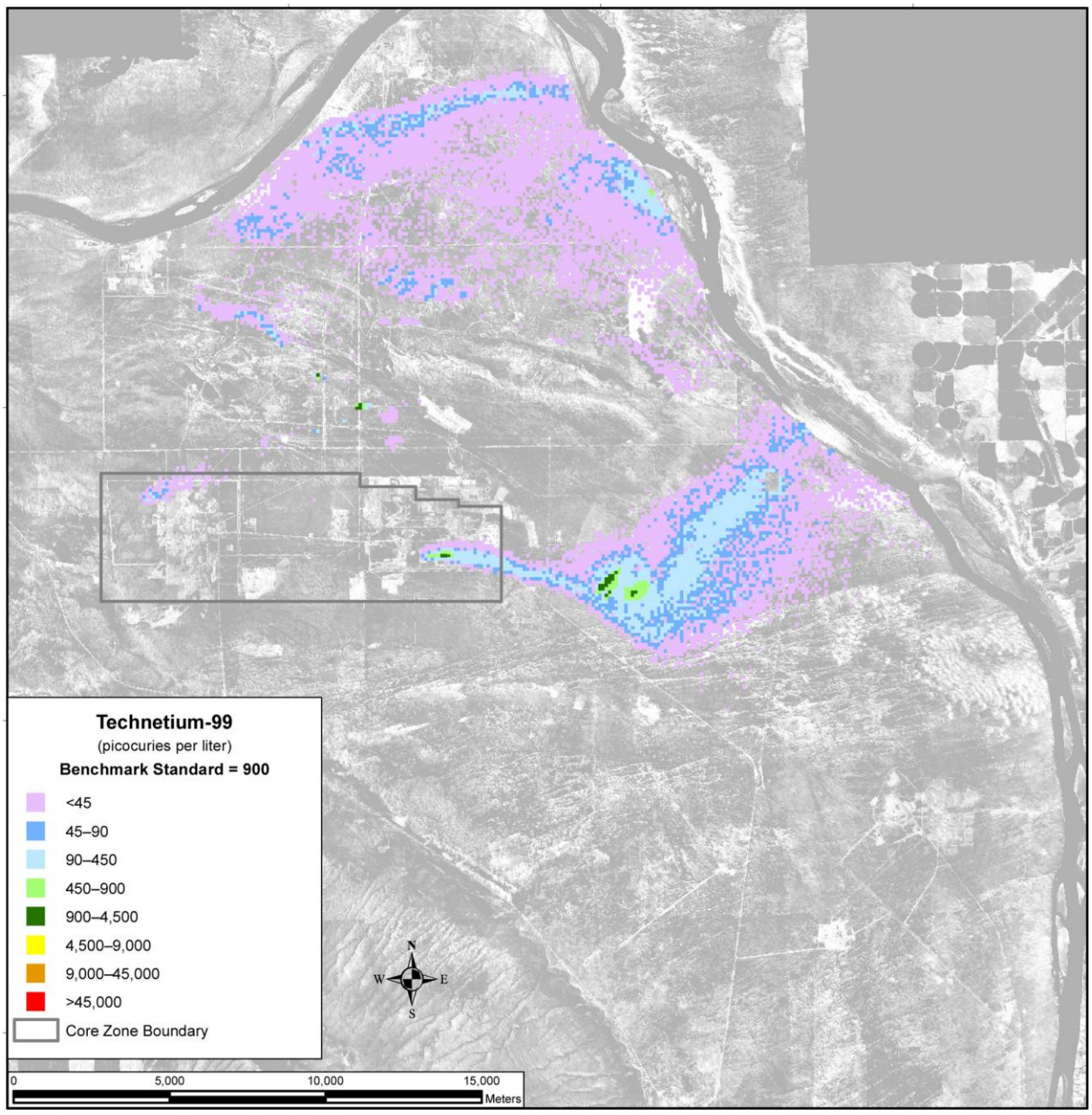
Note: To convert meters to feet, multiply by 3.281.

Figure 5–773. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



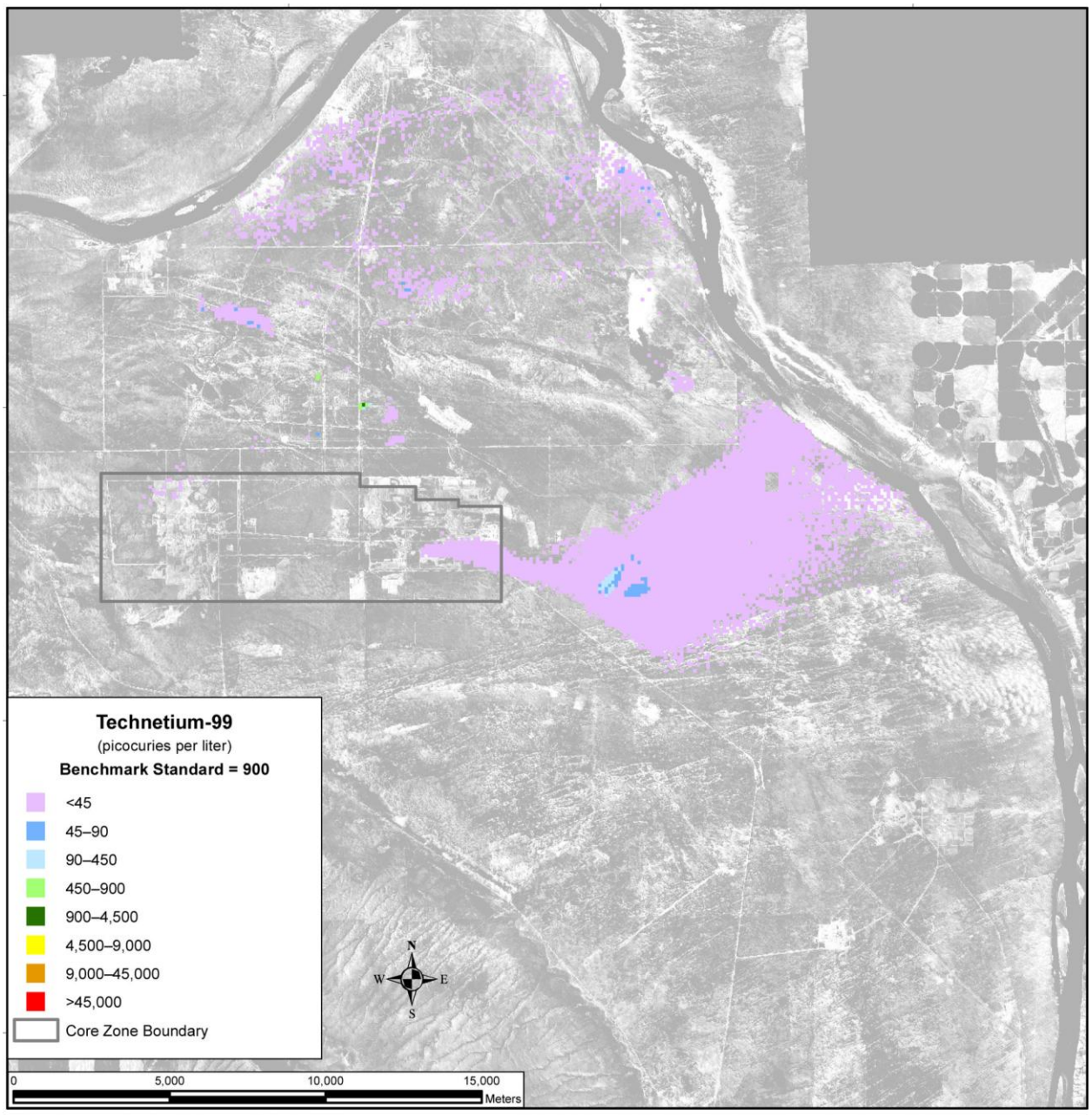
Note: To convert meters to feet, multiply by 3.281.

Figure 5–774. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



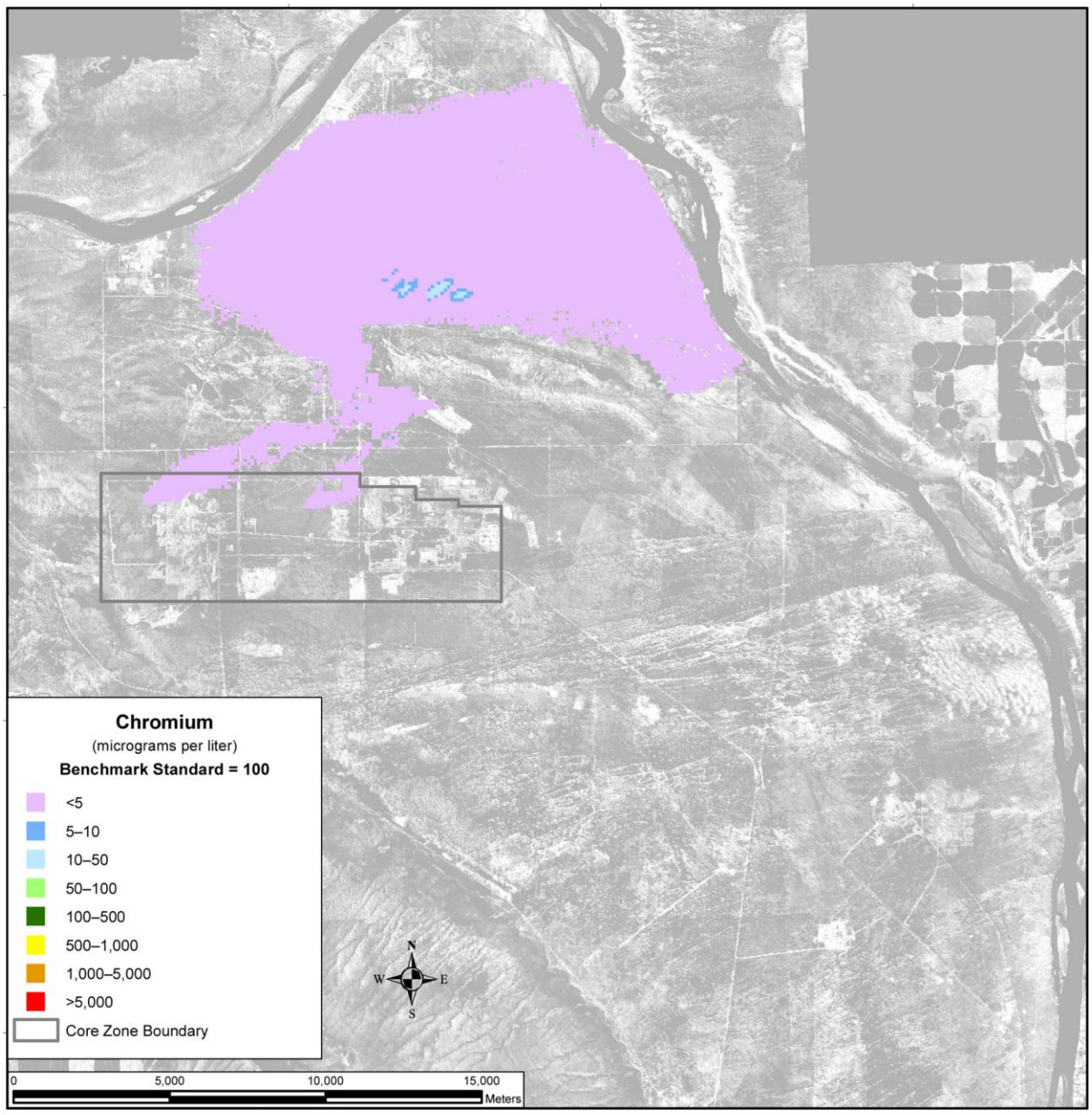
Note: To convert meters to feet, multiply by 3.281.

Figure 5–775. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



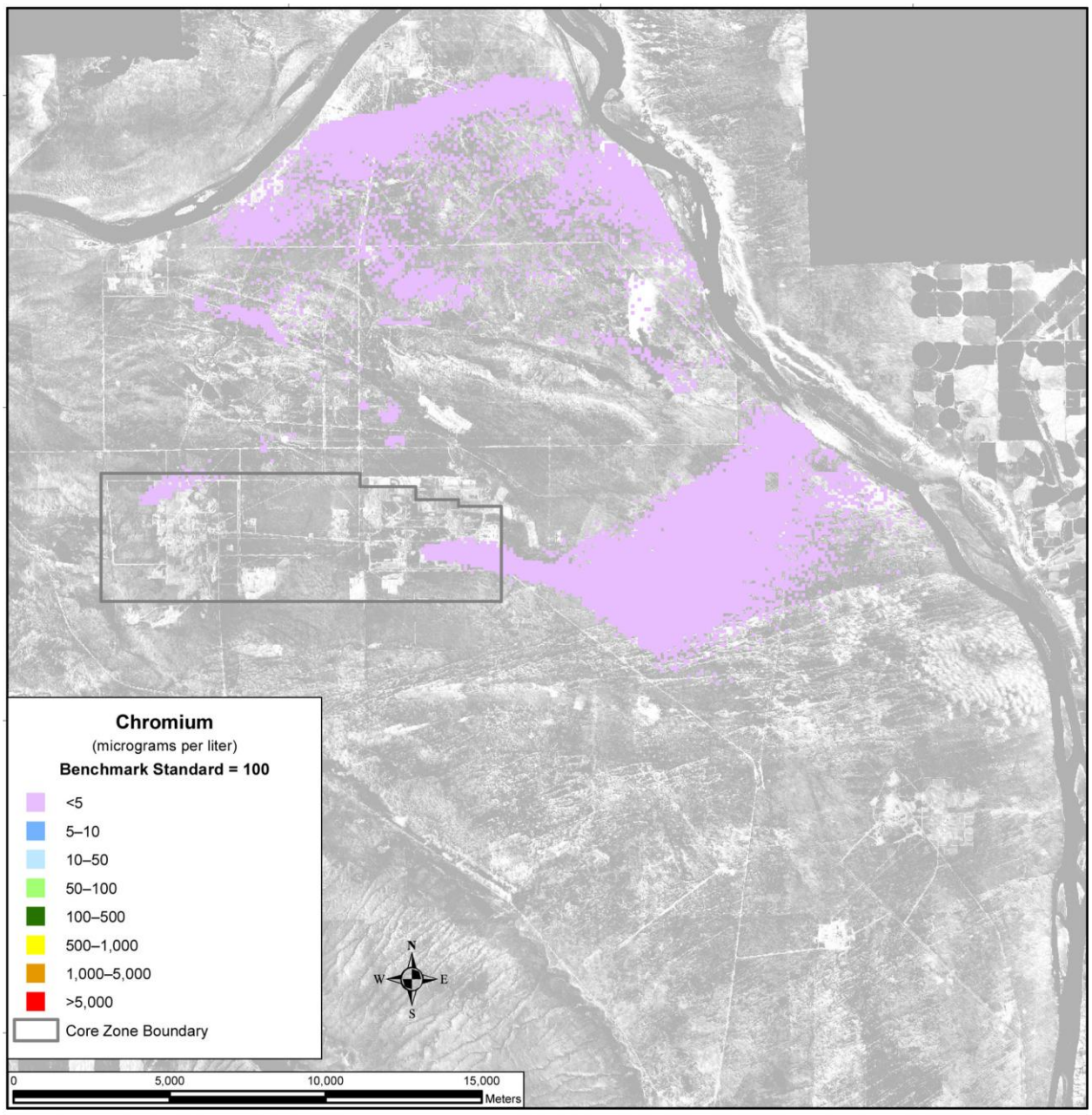
Note: To convert meters to feet, multiply by 3.281.

Figure 5–776. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



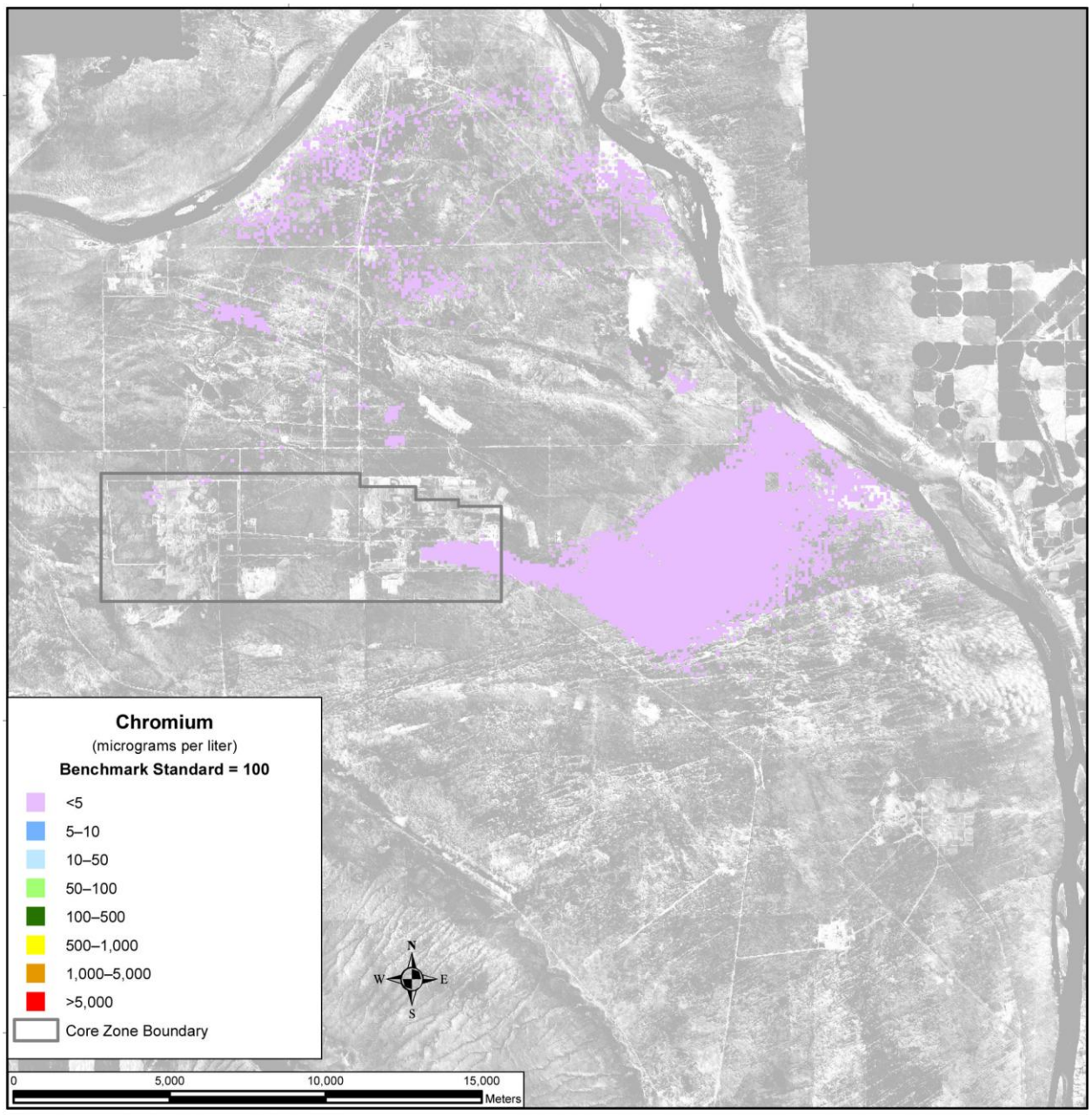
Note: To convert meters to feet, multiply by 3.281.

Figure 5–777. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



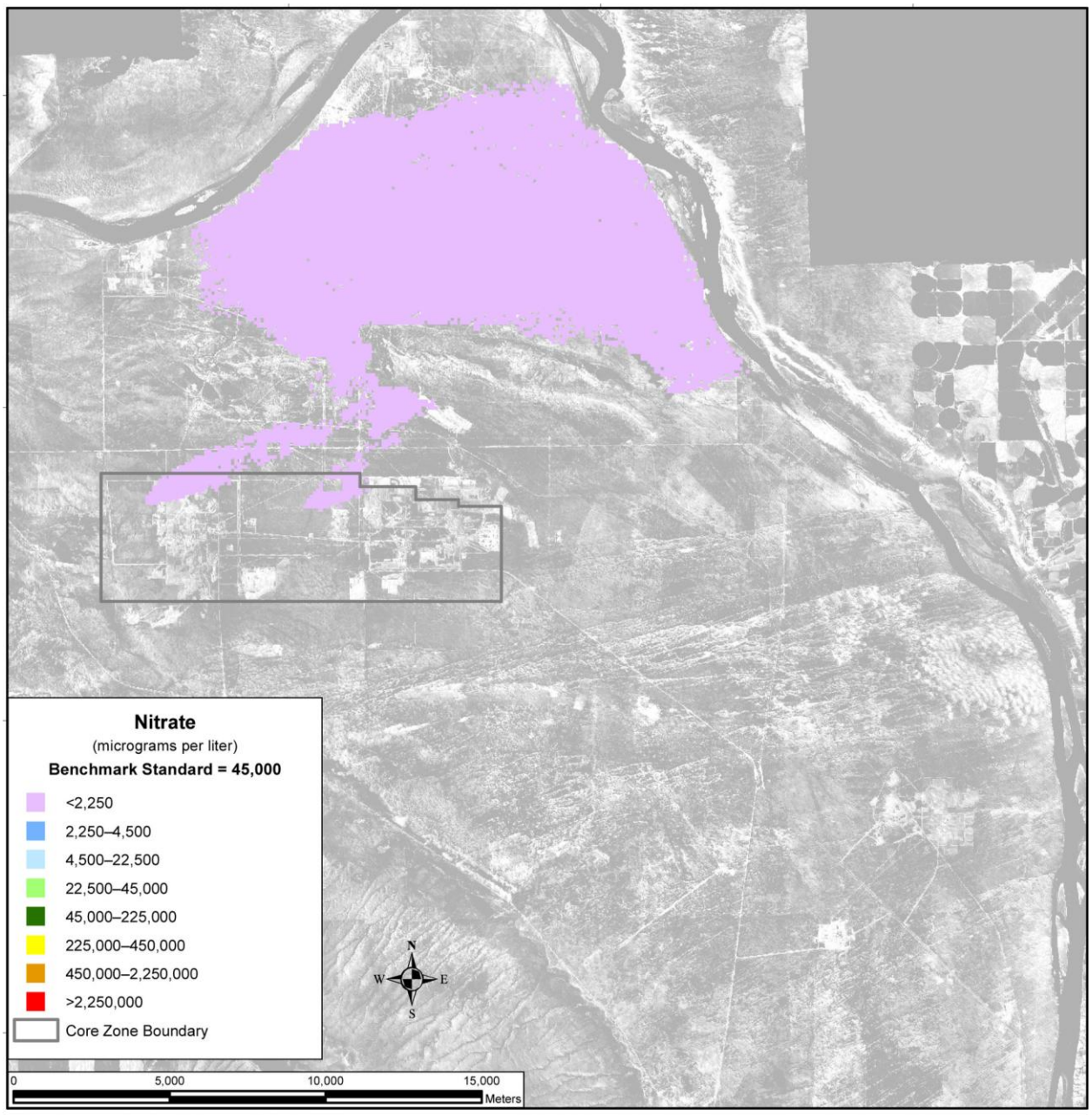
Note: To convert meters to feet, multiply by 3.281.

Figure 5–778. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



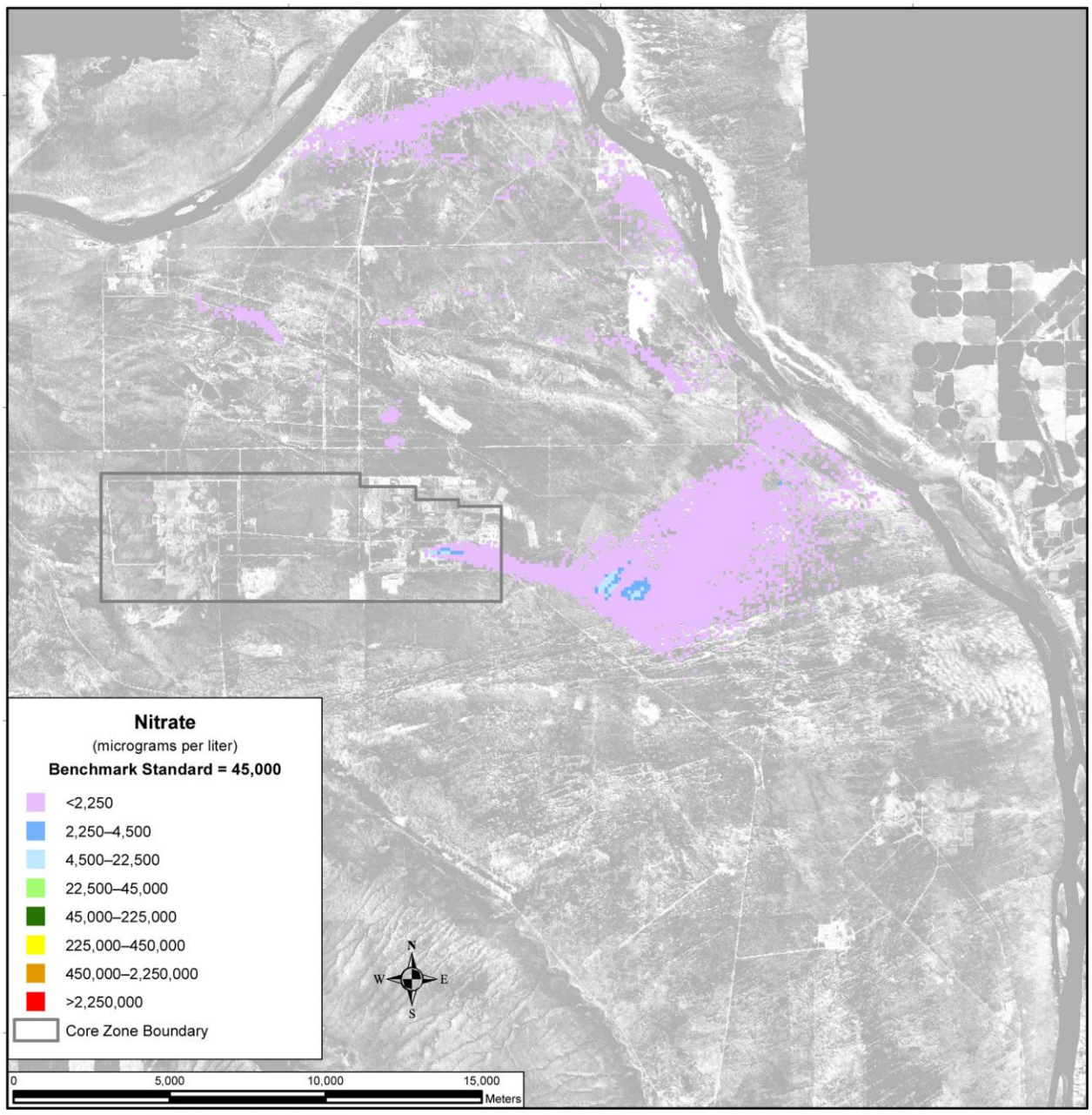
Note: To convert meters to feet, multiply by 3.281.

Figure 5–779. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



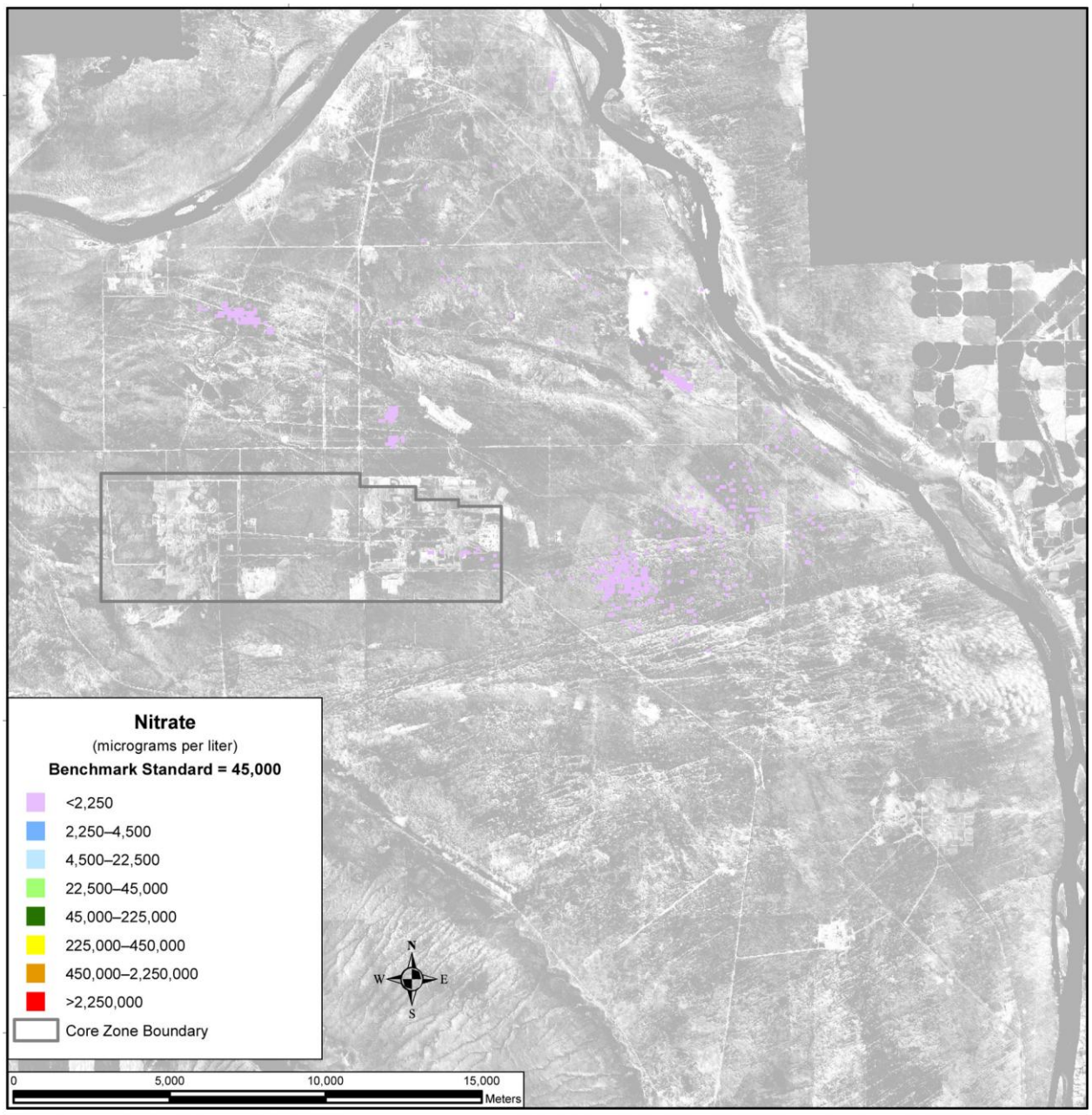
Note: To convert meters to feet, multiply by 3.281.

Figure 5–780. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–781. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–782. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in general, the inventories remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For the conservative tracers, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentration at the Columbia River is about one to two orders of magnitude smaller. The intensities and areas of these groundwater plumes peak between CYs 3200 and 7000.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of total uranium remain six orders of magnitude below the benchmark at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore for the duration of the 10,000-year simulation period.

5.3.1.3.1.3 Disposal Group 1, Subgroup 1-C

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW, ILAW glass, and cast stone waste. IHLW would be stored on site, while ILAW glass and cast stone waste would be disposed of in an IDF.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contribution to risk and hazard are not dominant during the year of peak risk or hazard, they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, acetonitrile, chromium, and nitrate are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers.

Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Nine subtotals are plotted in Figures 5–783 through 5–800, representing releases from IDF-East, which include ILAW glass, cast stone waste, ETF-generated secondary waste, retired melters, and tank closure secondary waste; releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste; and releases from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over eight orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–783 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–784, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., nearly all of the inventory is released during the period of analysis). The predominant source of chromium, nitrate, iodine-129, and technetium-99 is cast stone waste. Other sources of contamination examined include ILAW glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste. Fluoride is not released from IDF-East.

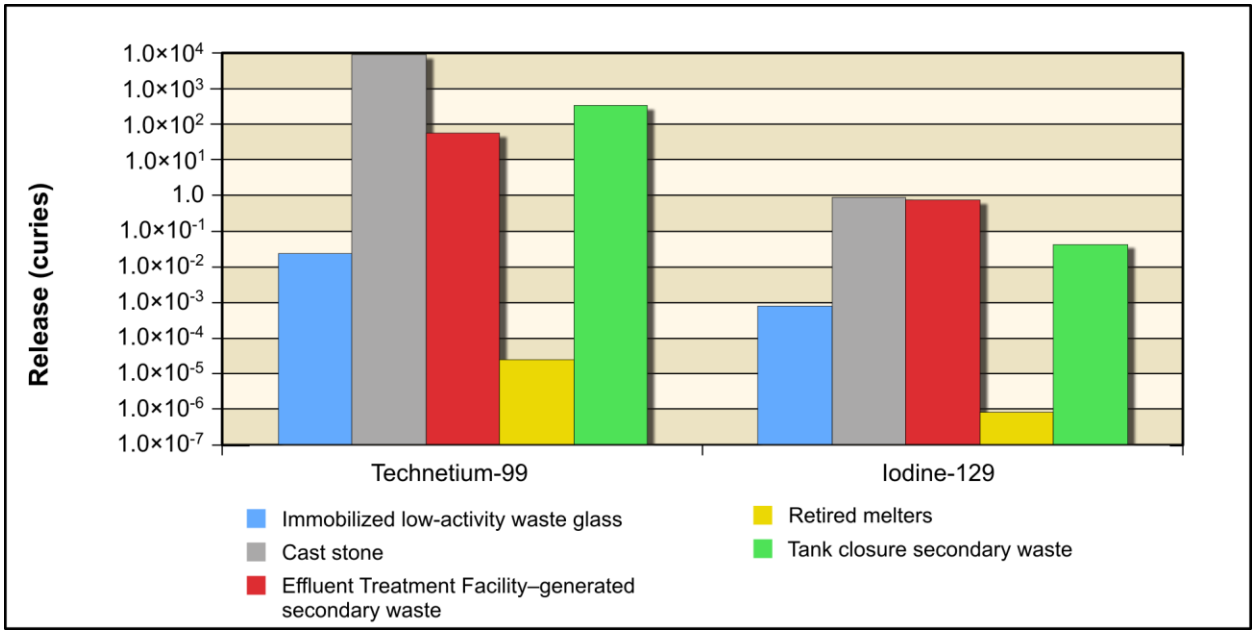


Figure 5–783. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

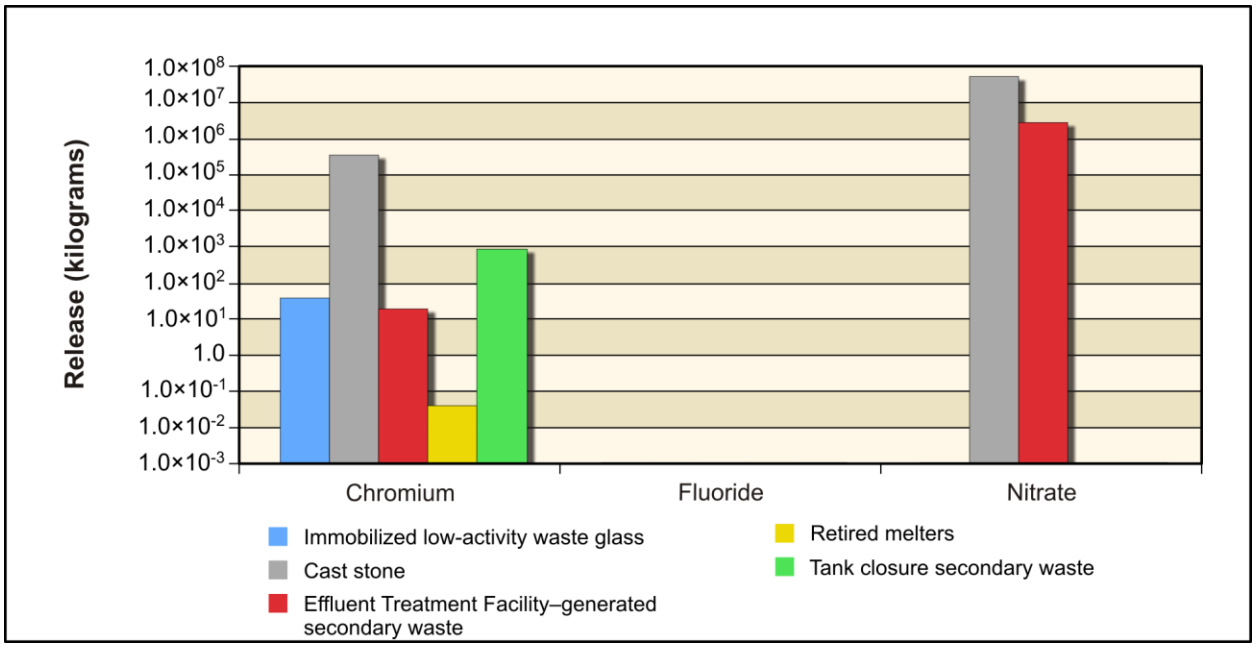


Figure 5–784. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–785 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–786, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all of the technetium-99 released from ETF-generated secondary waste to the vadose zone reaches groundwater during the period of analysis, but only 40 to 50 percent of the technetium-99 from other sources and iodine-129 released to the vadose zone reaches groundwater. Chromium from ILAW glass and retired melters behaves similarly to technetium-99 and iodine-129 in that only 40 to 50 percent of the chromium released to the vadose zone reaches groundwater. When released from other sources, nearly all the chromium that enters the vadose zone reaches groundwater during the analysis period. For nitrate, nearly everything released to the vadose zone reaches groundwater. Fluoride is not released to the vadose zone from IDF-East.

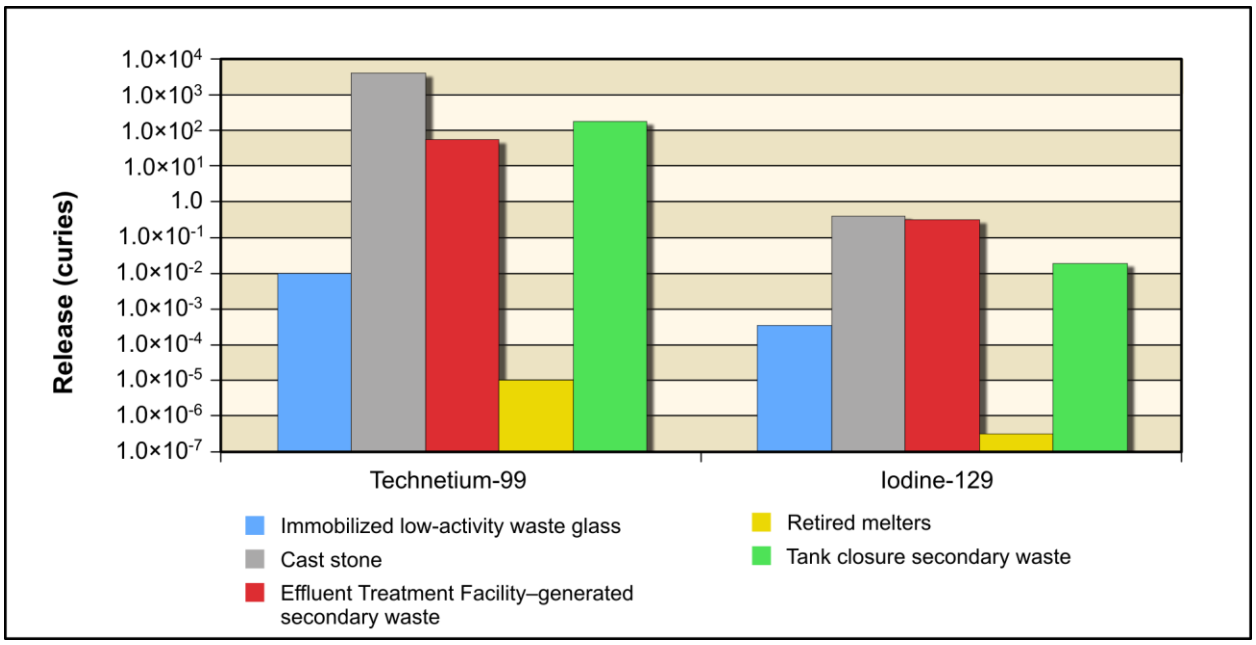


Figure 5–785. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

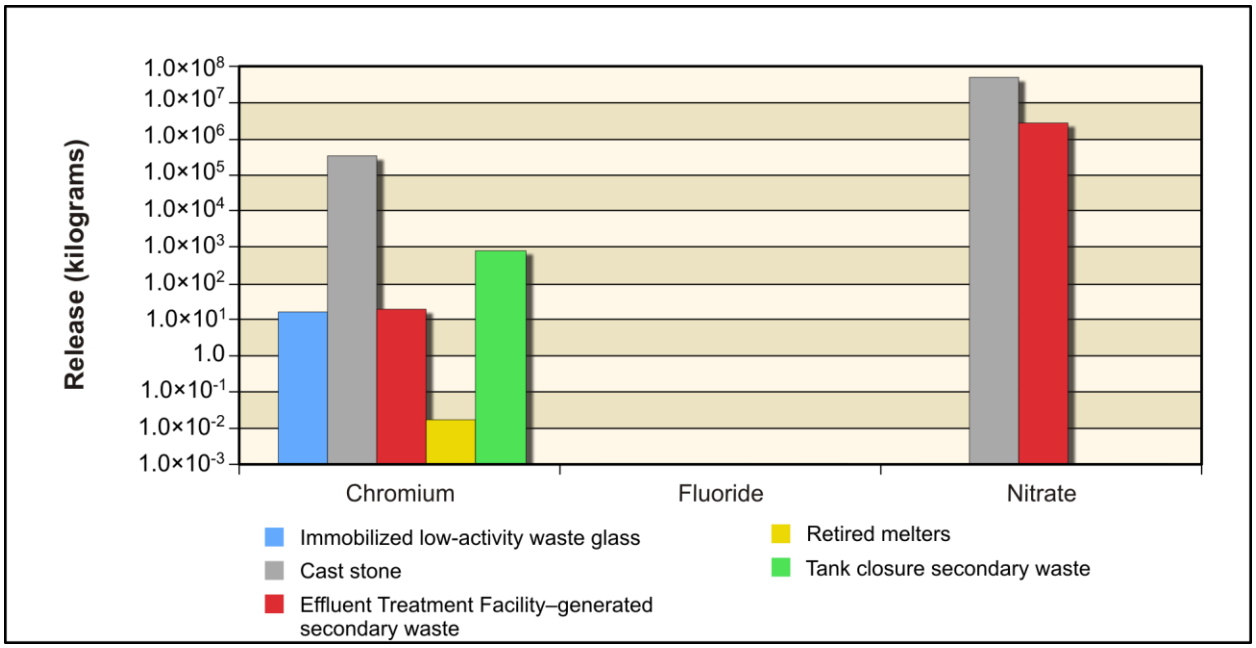


Figure 5–786. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–787 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–788, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In nearly all cases, between 90 and 100 percent of the amount released to groundwater reaches the Columbia River in the analysis. The exception to this trend is waste from retired melters for technetium-99 and iodine-129. In this case, nothing released to groundwater reaches the Columbia River.

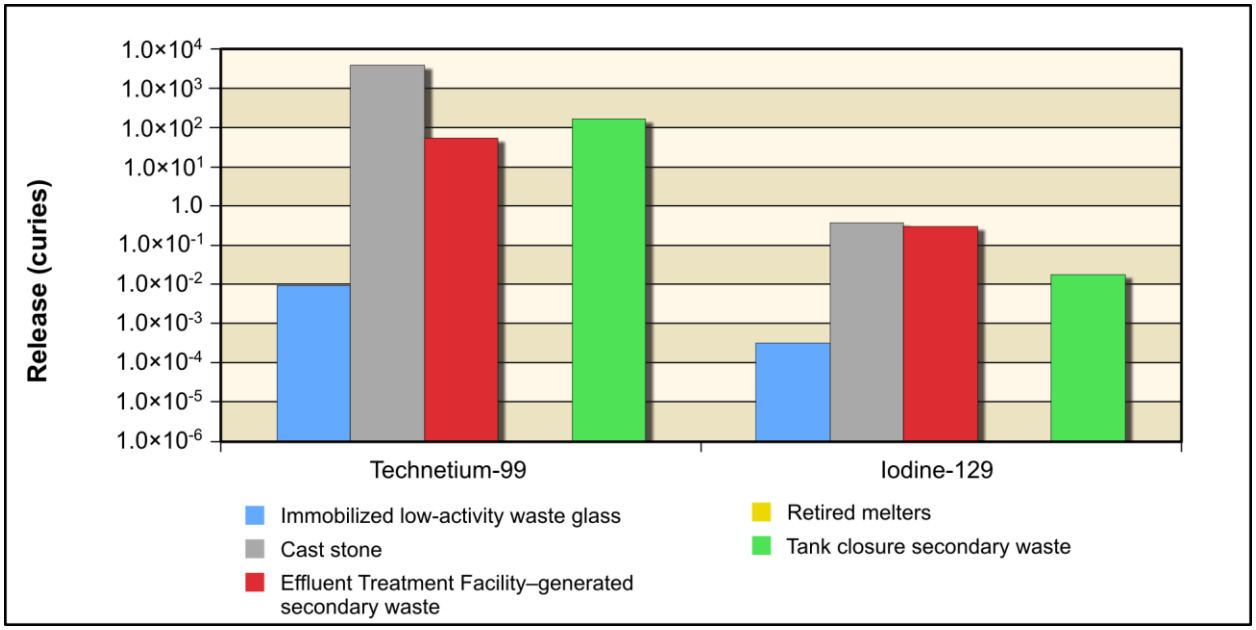


Figure 5–787. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

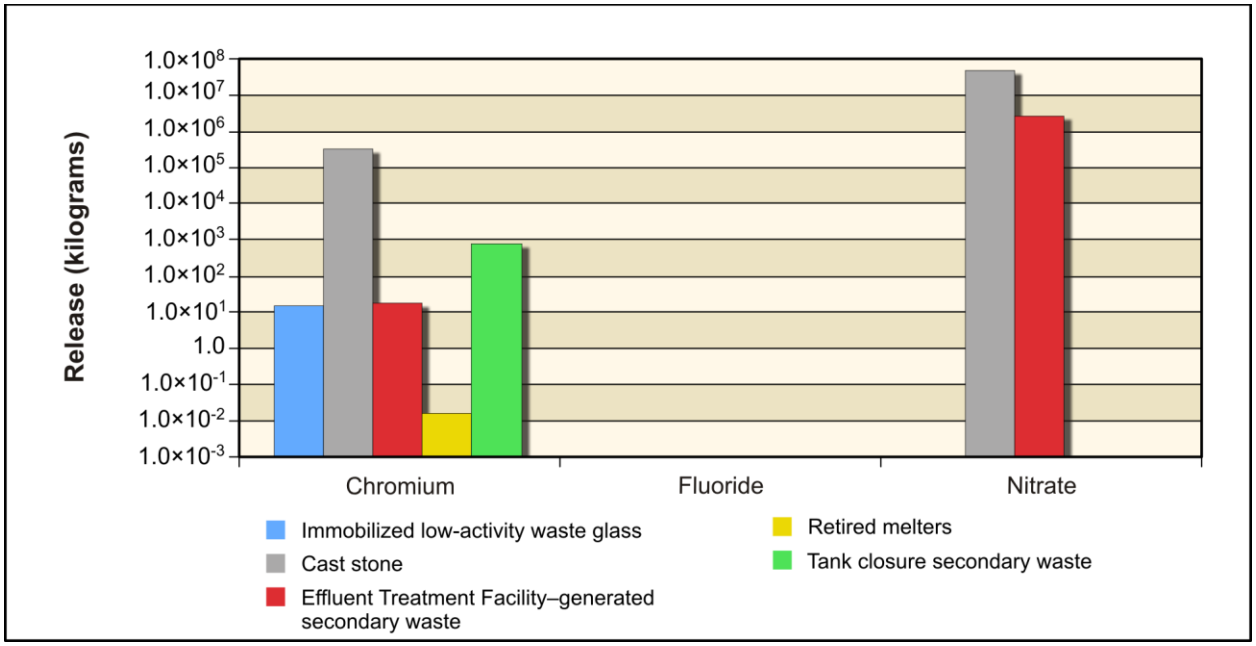


Figure 5–788. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Figure 5–789 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–790, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, fluoride, and nitrate are all present at IDF-West.

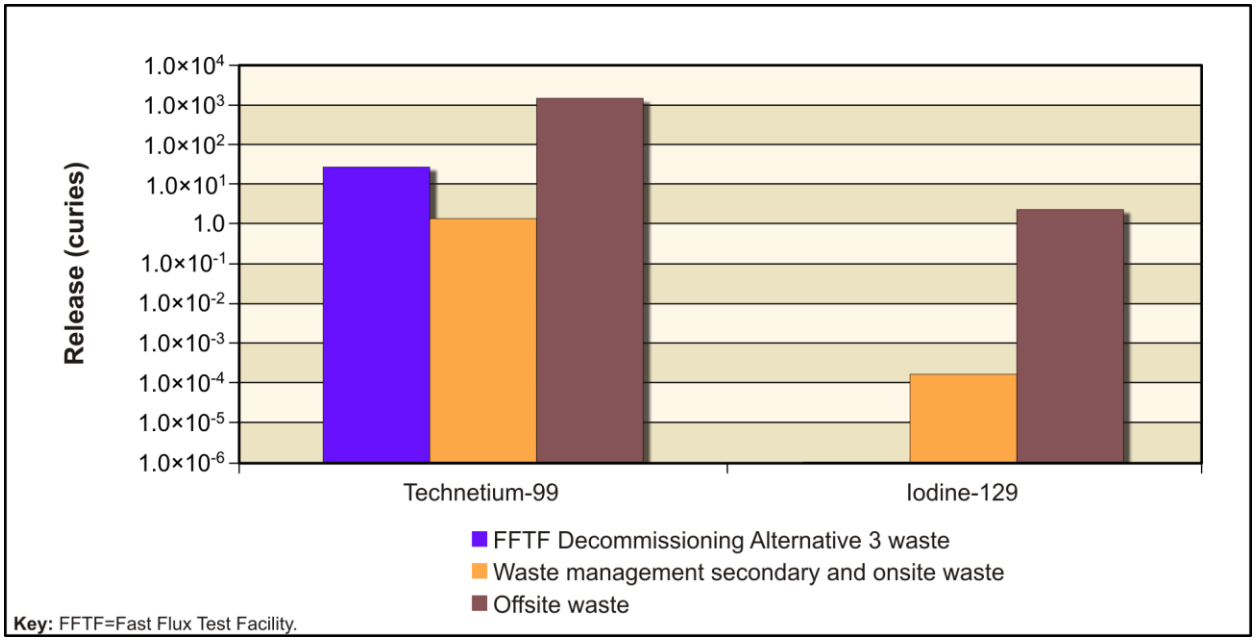


Figure 5–789. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

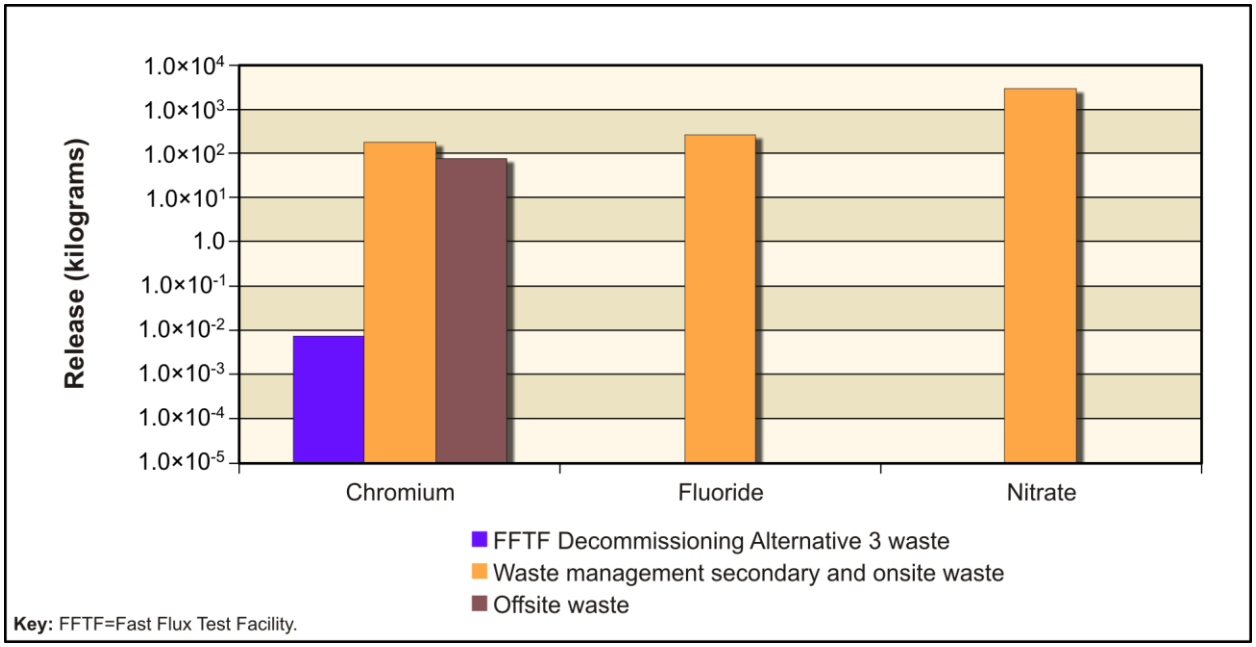


Figure 5–790. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–791 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–792, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at IDF-West behave as conservative tracers; essentially all of the mass released to the vadose zone reaches groundwater in the analysis.

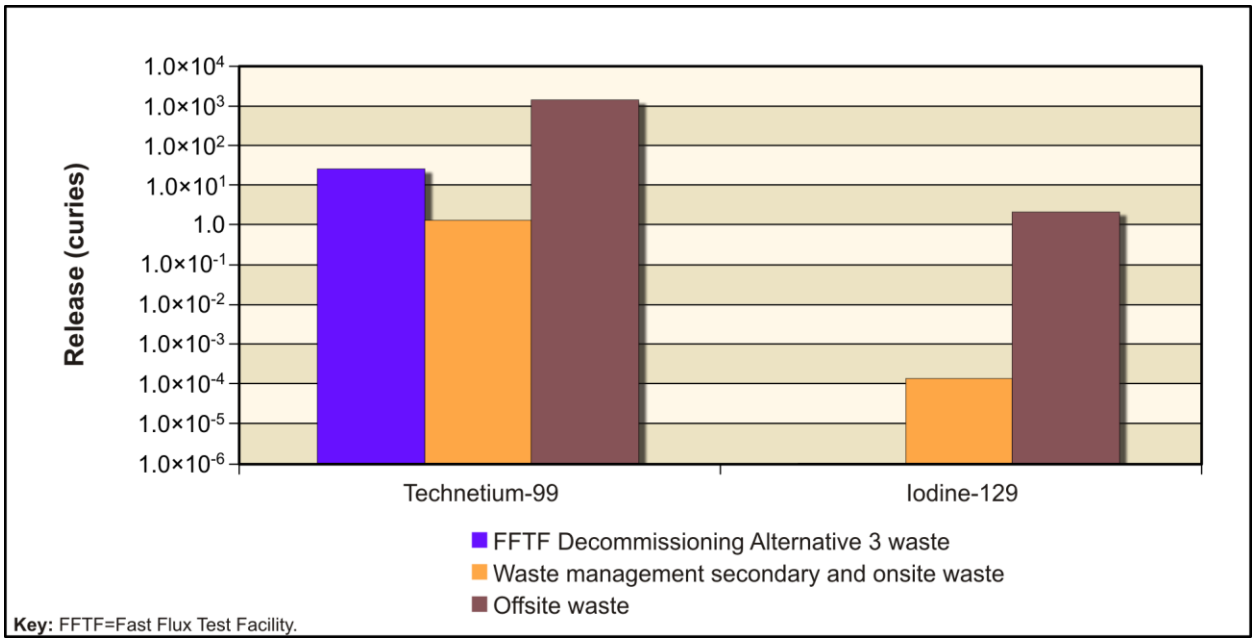


Figure 5–791. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

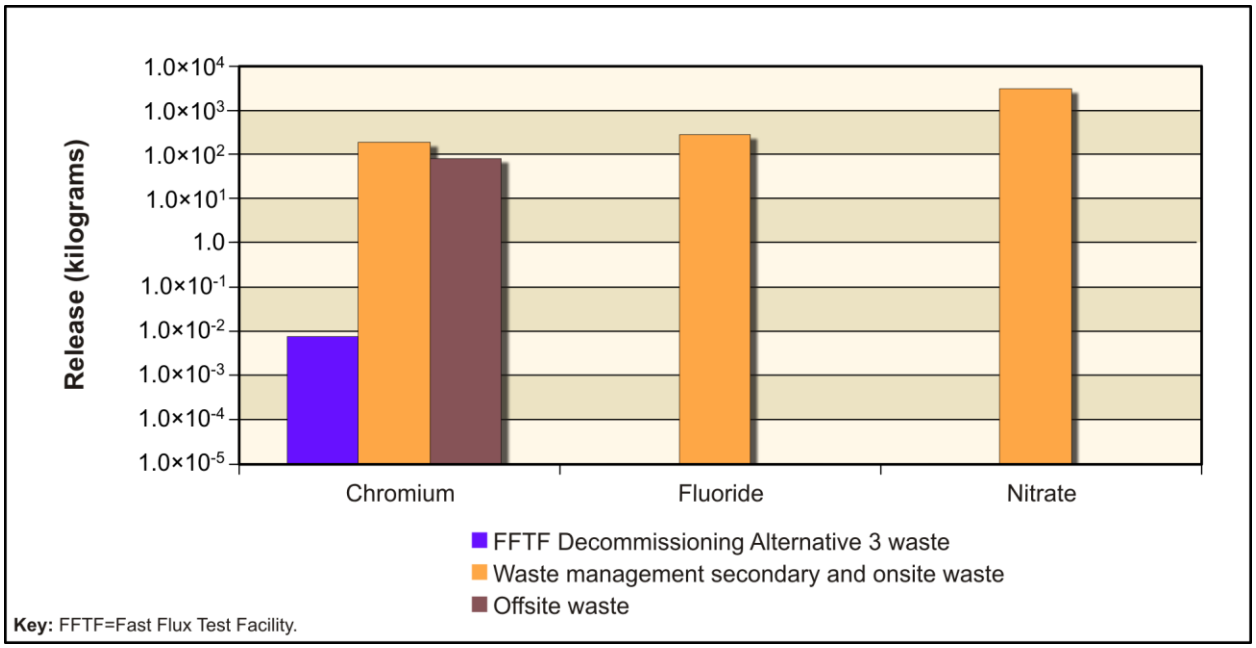


Figure 5–792. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–793 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–794, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In the analysis, essentially everything released to groundwater reaches the Columbia River for all COPC drivers present.

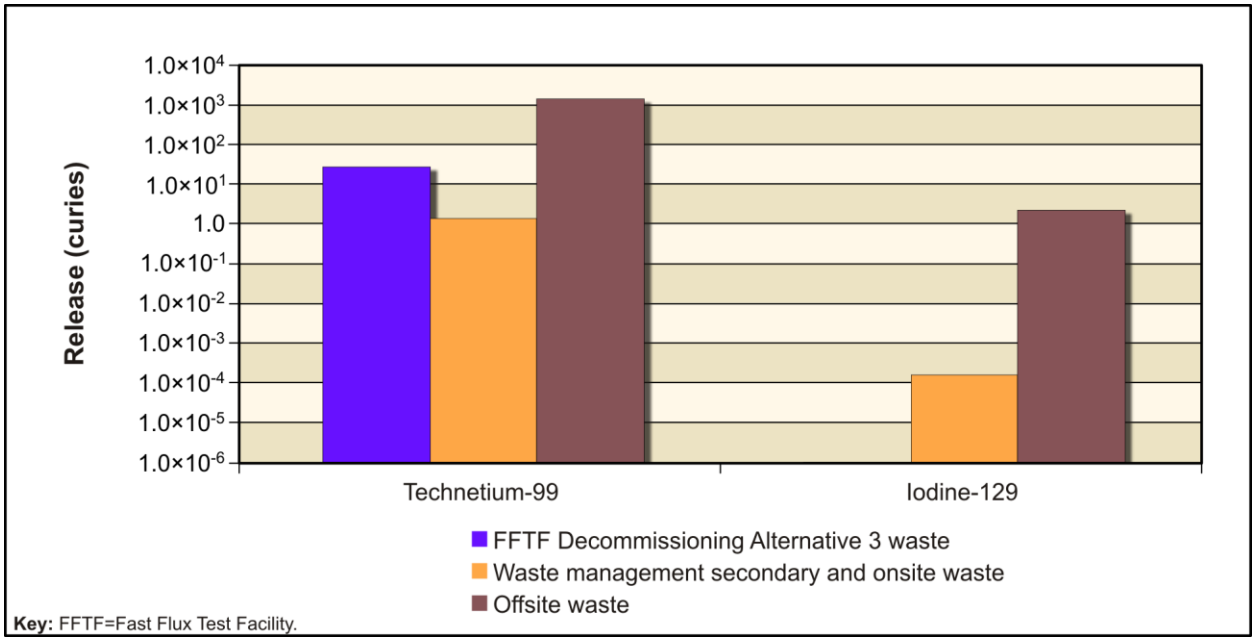


Figure 5–793. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

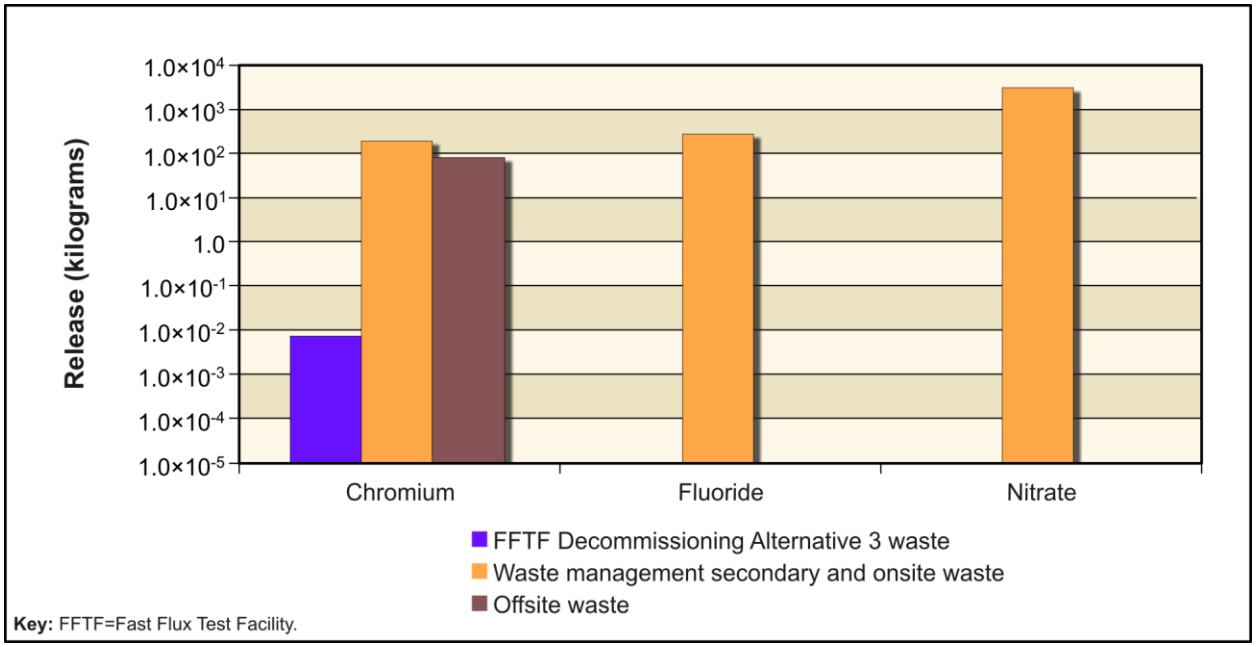


Figure 5–794. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–795 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–796, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

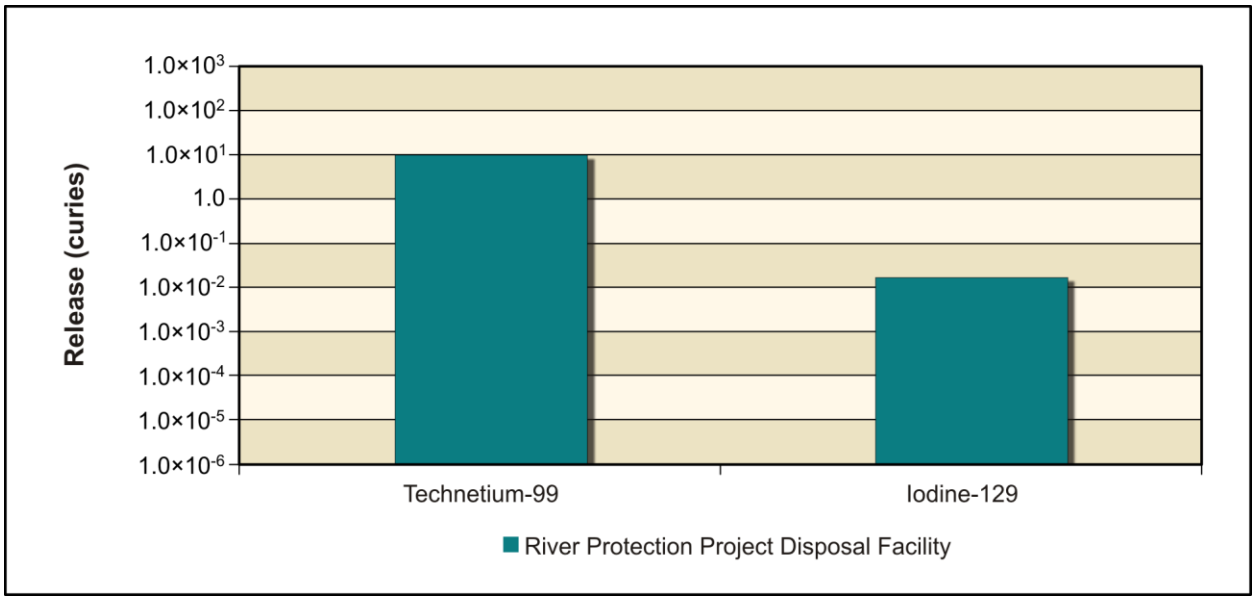


Figure 5–795. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

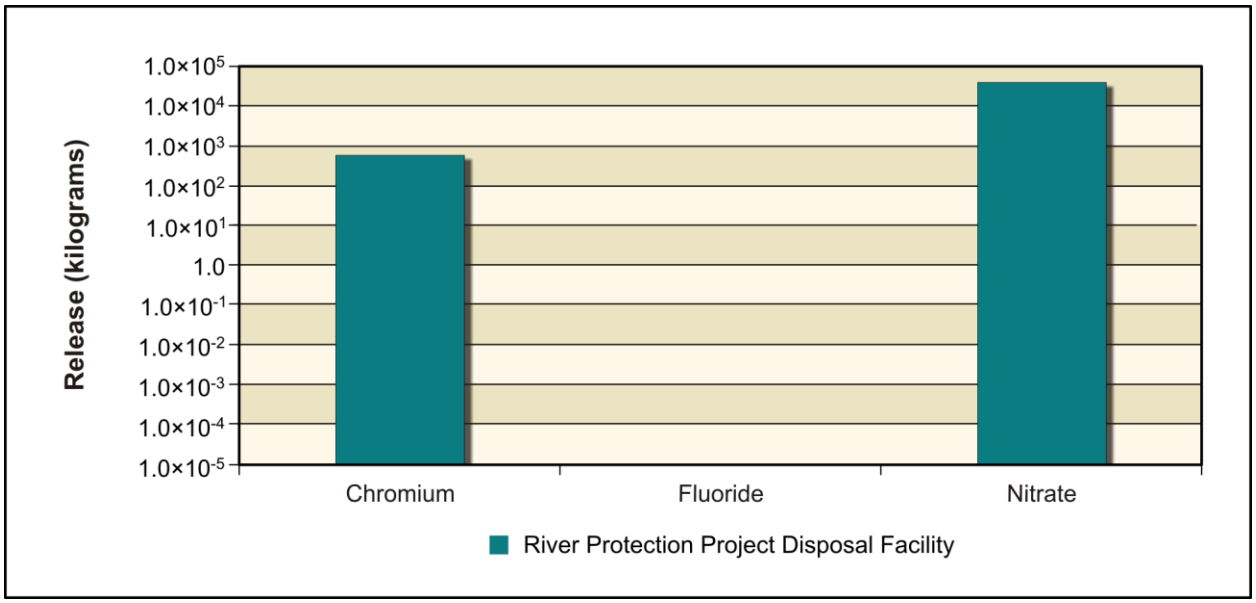


Figure 5–796. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–797 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–798, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers; essentially all of the mass released to the vadose zone reaches groundwater in the analysis.

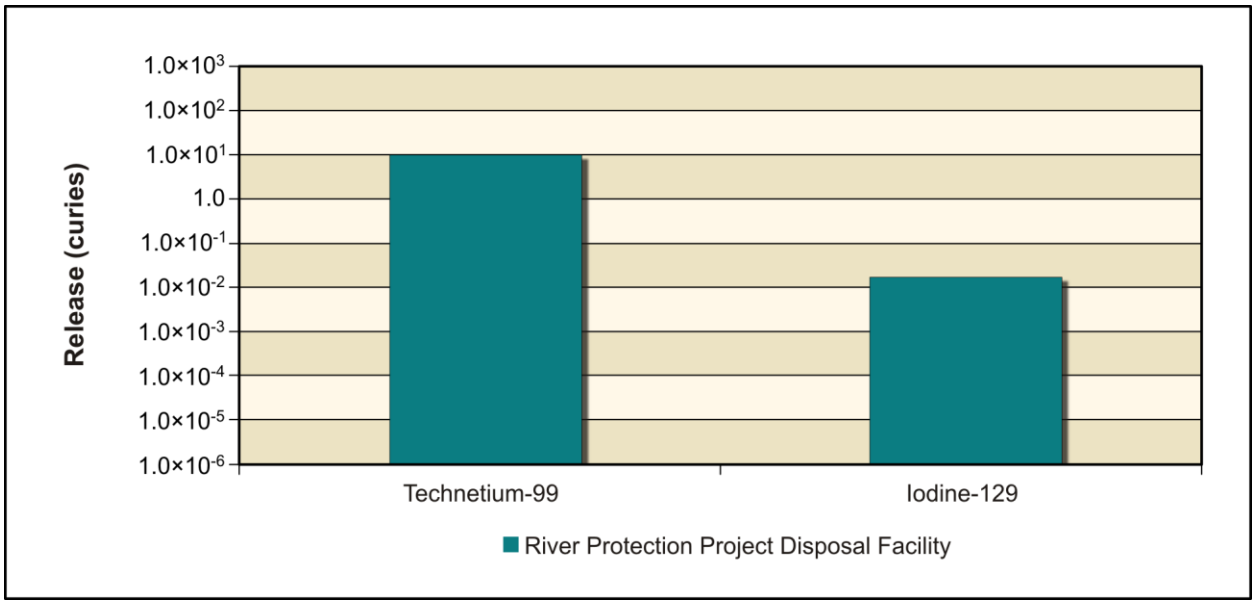


Figure 5–797. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

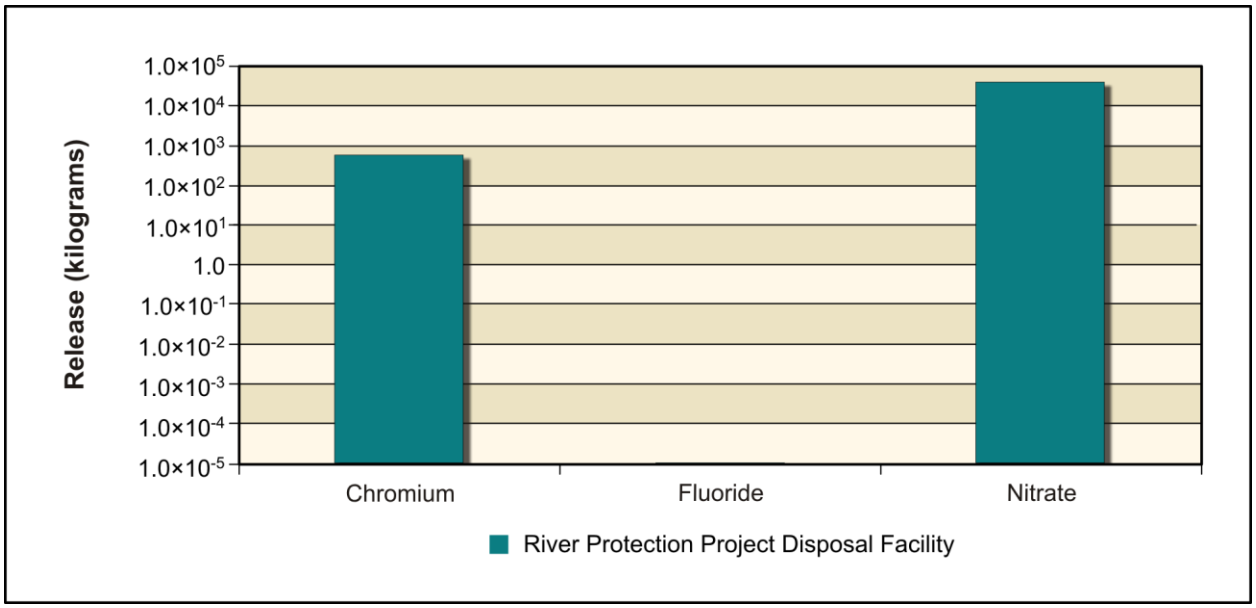


Figure 5–798. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–799 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–800, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In the analysis, essentially everything released to groundwater reaches the Columbia River for all COPC drivers present.

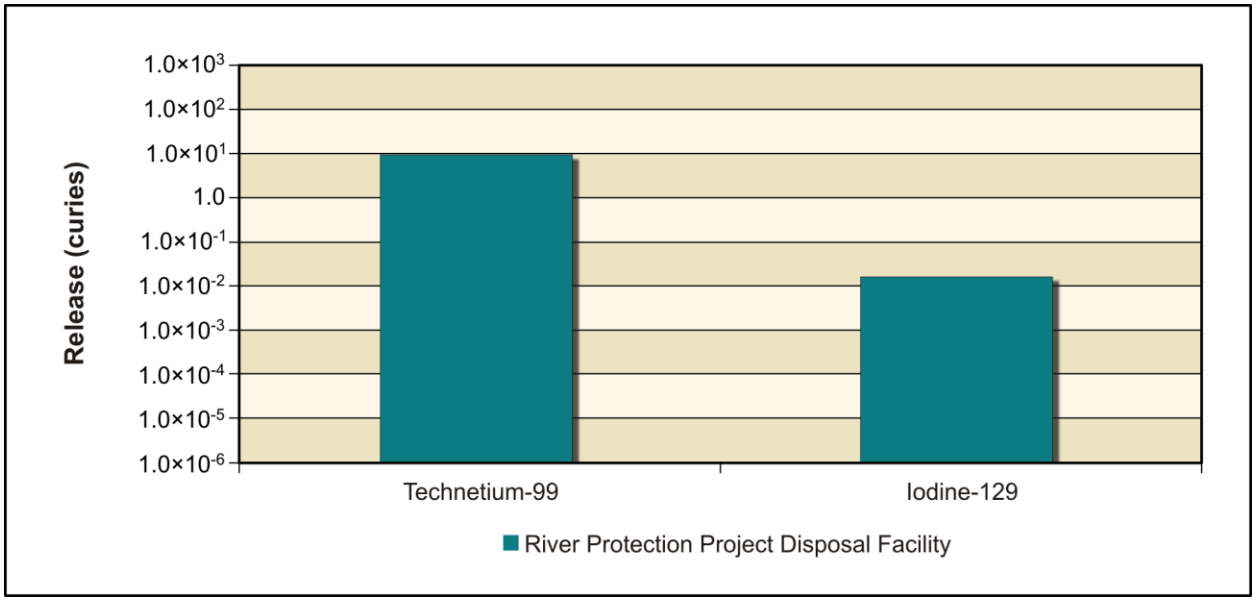


Figure 5–799. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

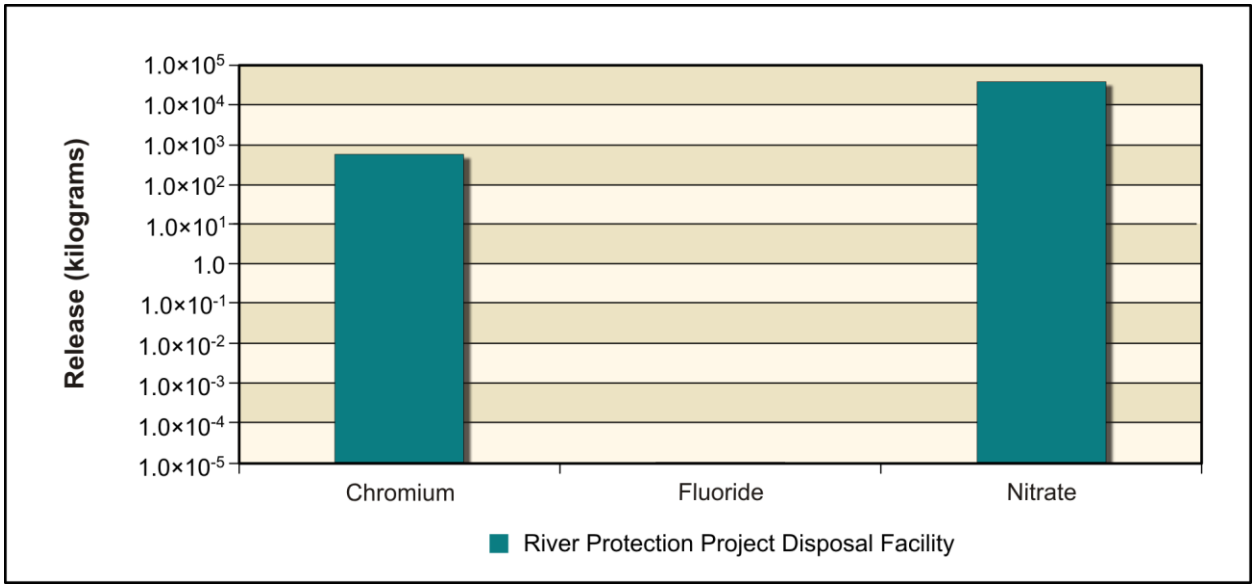


Figure 5–800. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the

concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude. Table 5–108 shows the maximum concentrations in groundwater. The most impacted barriers include IDF-West, the Core Zone Boundary, and the Columbia River nearshore, where technetium-99 and iodine-129 reach their maximum exceedances of the benchmark concentrations after about CY 3800; technetium-99 also exceeds the benchmark concentration at IDF-East late in the simulation. Chromium reaches its maximum exceedance of the benchmark concentration at IDF-East and the Core Zone Boundary, and nitrate reaches its maximum exceedance at IDF-East.

Table 5–108. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**2,970**	**13,200**	42	**1,370**	**1,670**	900
	(10,774)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	0.4	**20.6**	0.1	**2.1**	**2.4**	1
	(9623)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Acetonitrile	17	0	0	6	4	100
	(8821)	(1940)	(1940)	(8715)	(8940)	
Chromium	**295**	1	3	**102**	78	100
	(8608)	(3813)	(3740)	(8680)	(8594)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	42,600	7	180	16,100	12,200	45,000
	(8888)	(3927)	(3670)	(8973)	(8783)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–801 through 5–804 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers), respectively. Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 5000. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6500. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is only approximately 1,500 years. In addition, the technetium-99 benchmark concentration is exceeded at the IDF-East barrier late in the analysis period, between CY 7000 and the end of the period, in CY 11,940. Chromium only exceeds the benchmark concentration at the IDF-East barrier over the time period from approximately CY 7000 to CY 11,000. Nitrate does not exceed its benchmark concentration at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

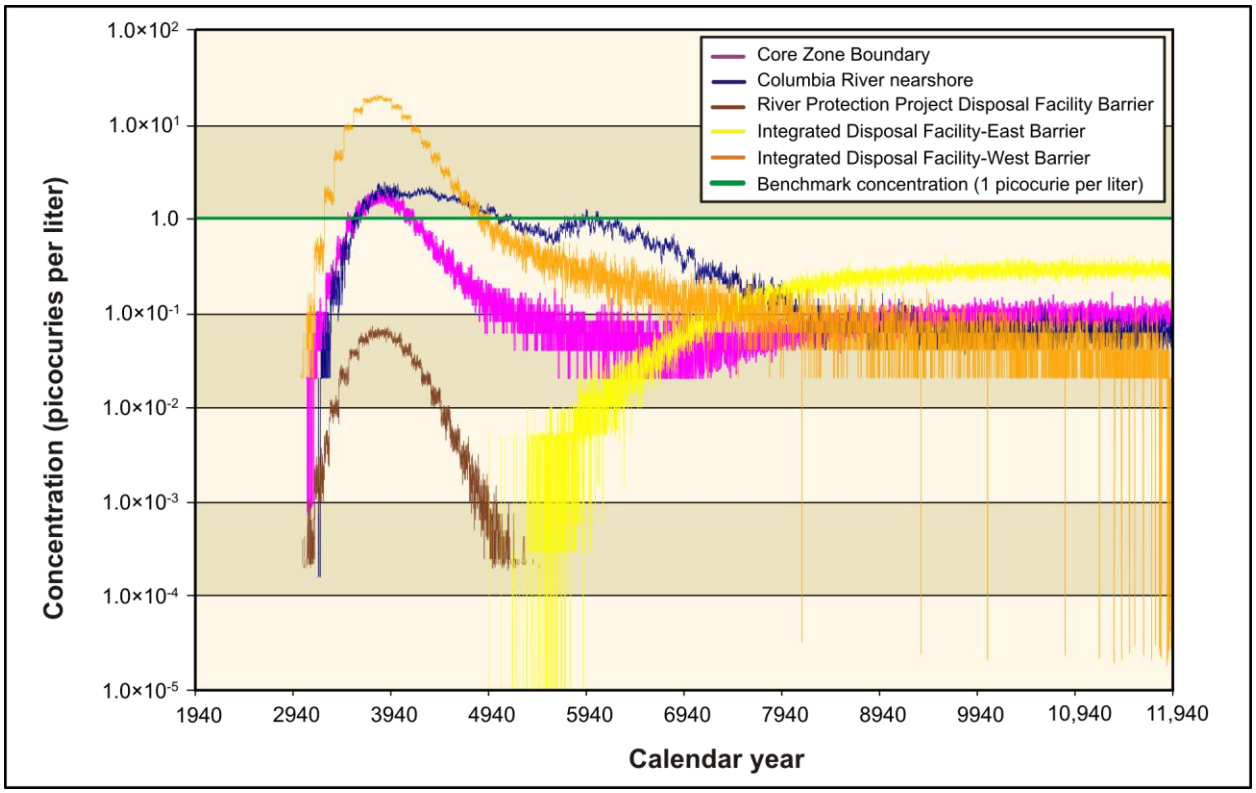


Figure 5–801. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Iodine-129 Concentration Versus Time

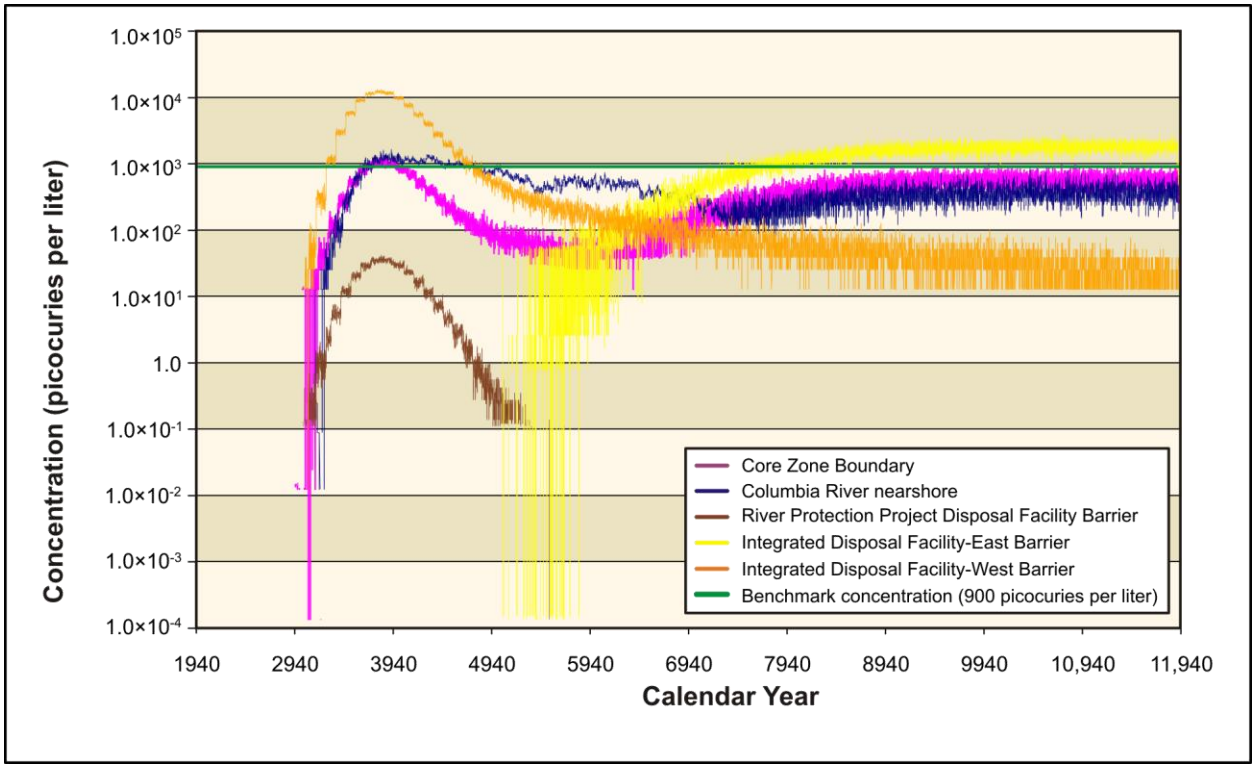


Figure 5–802. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Technetium-99 Concentration Versus Time

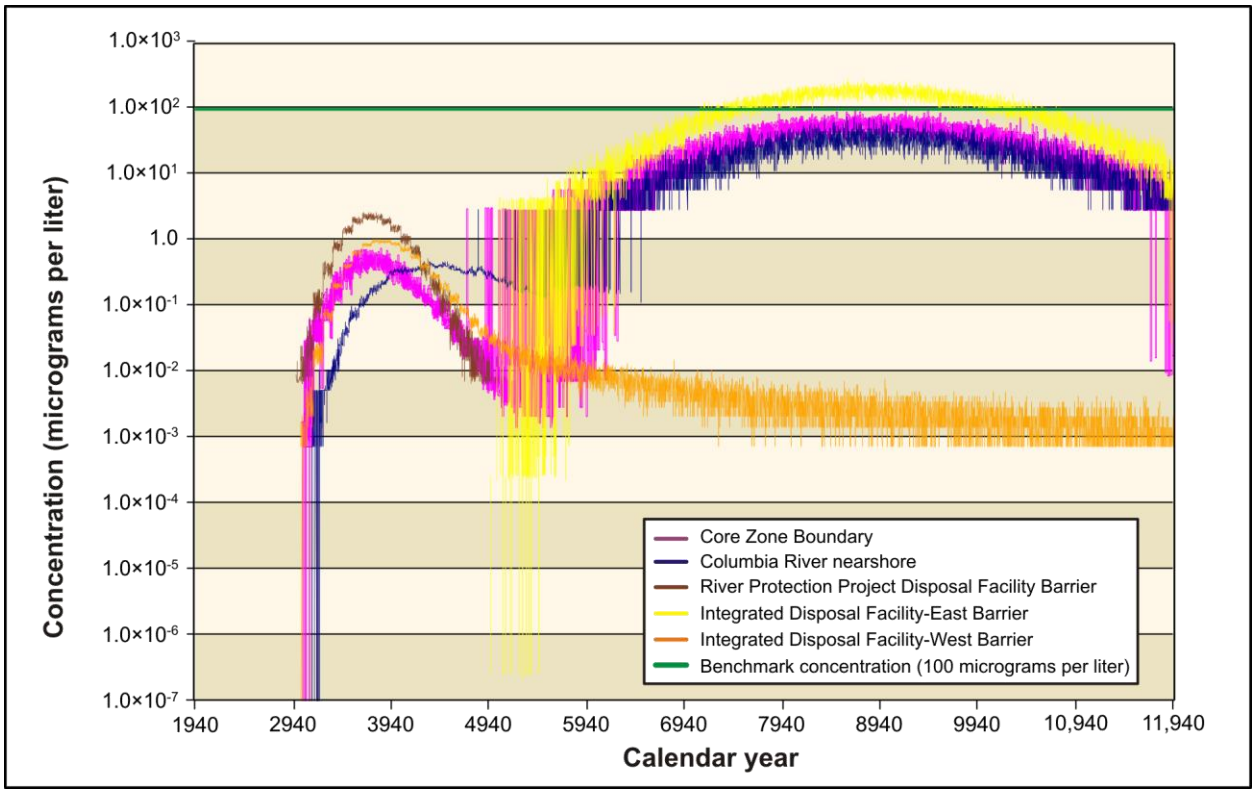


Figure 5–803. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chromium Concentration Versus Time

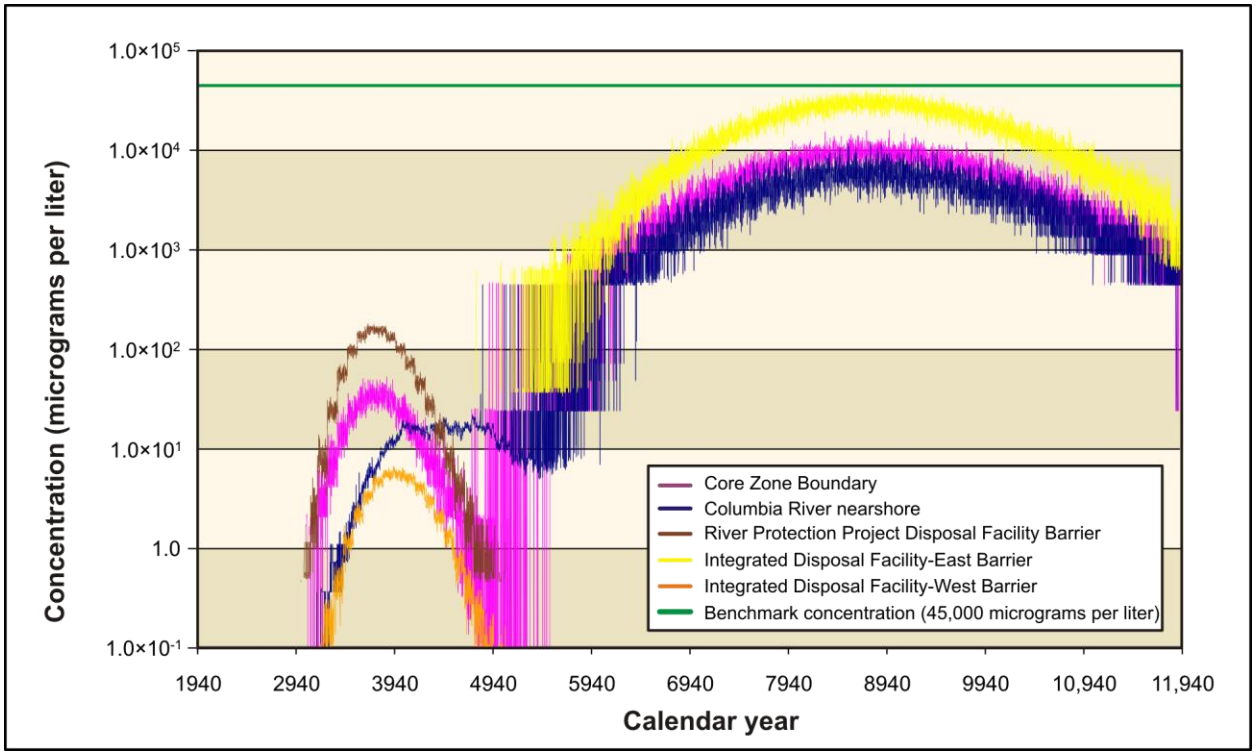


Figure 5–804. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Nitrate Concentration Versus Time

Figure 5–805 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while very minimal, begin to rise at the RPPDF barrier and Core Zone Boundary at approximately CY 10,000, but never get closer than seven orders of magnitude of exceeding benchmark concentrations by the end of the period of analysis.

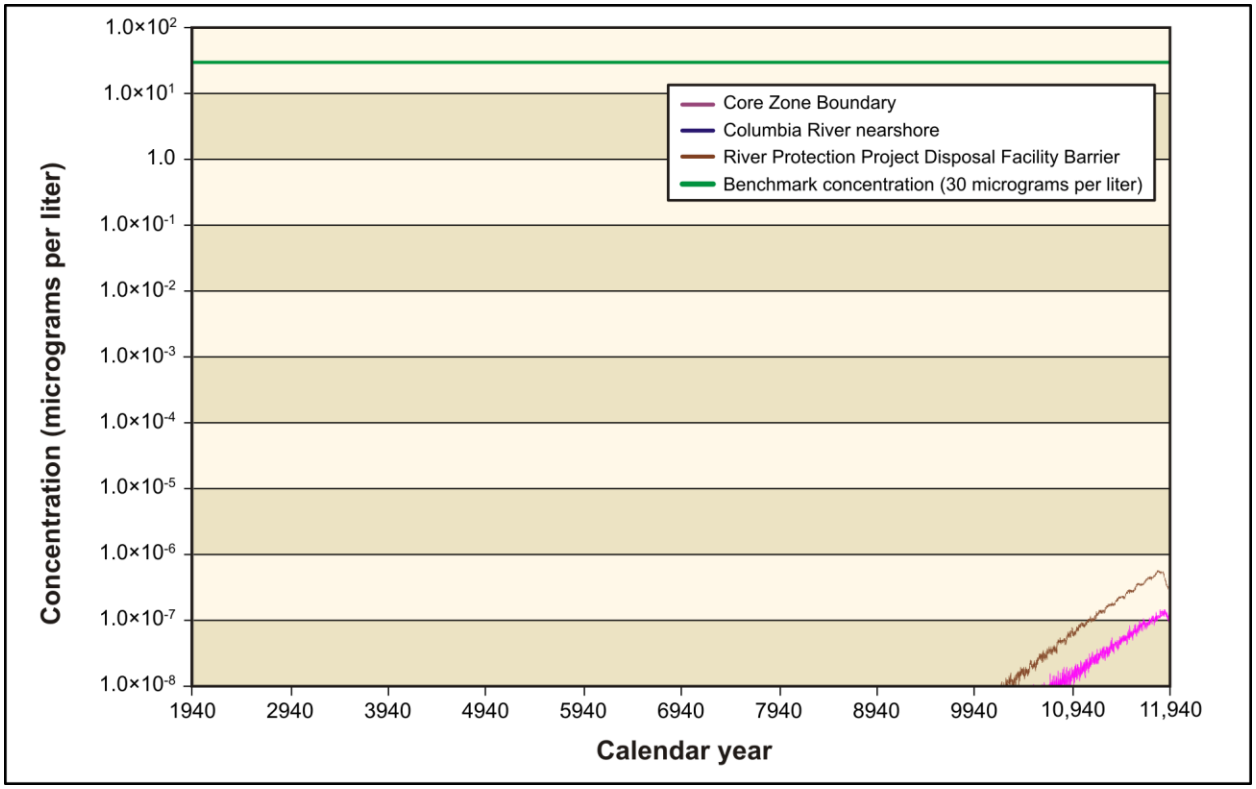


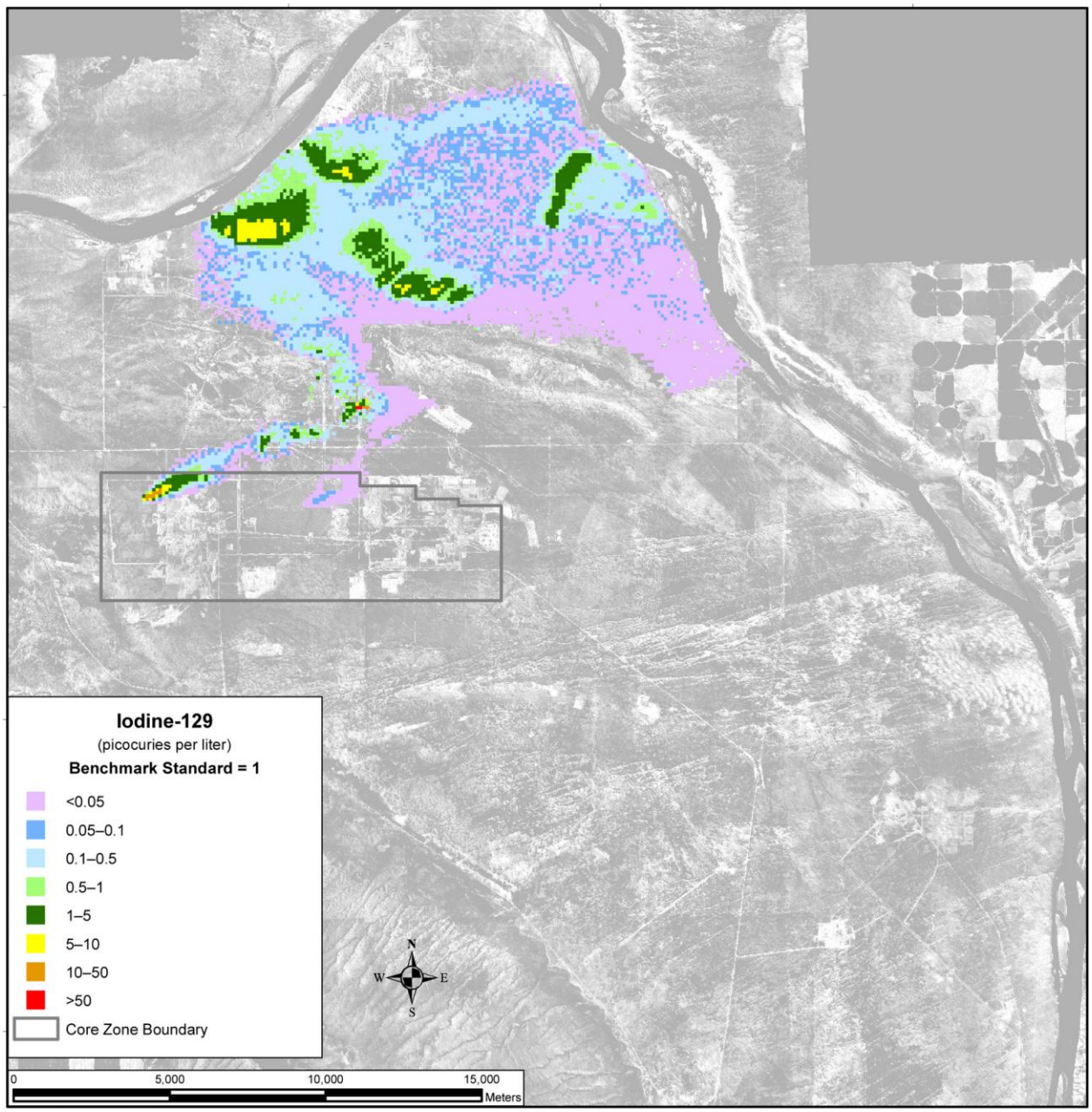
Figure 5–805. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

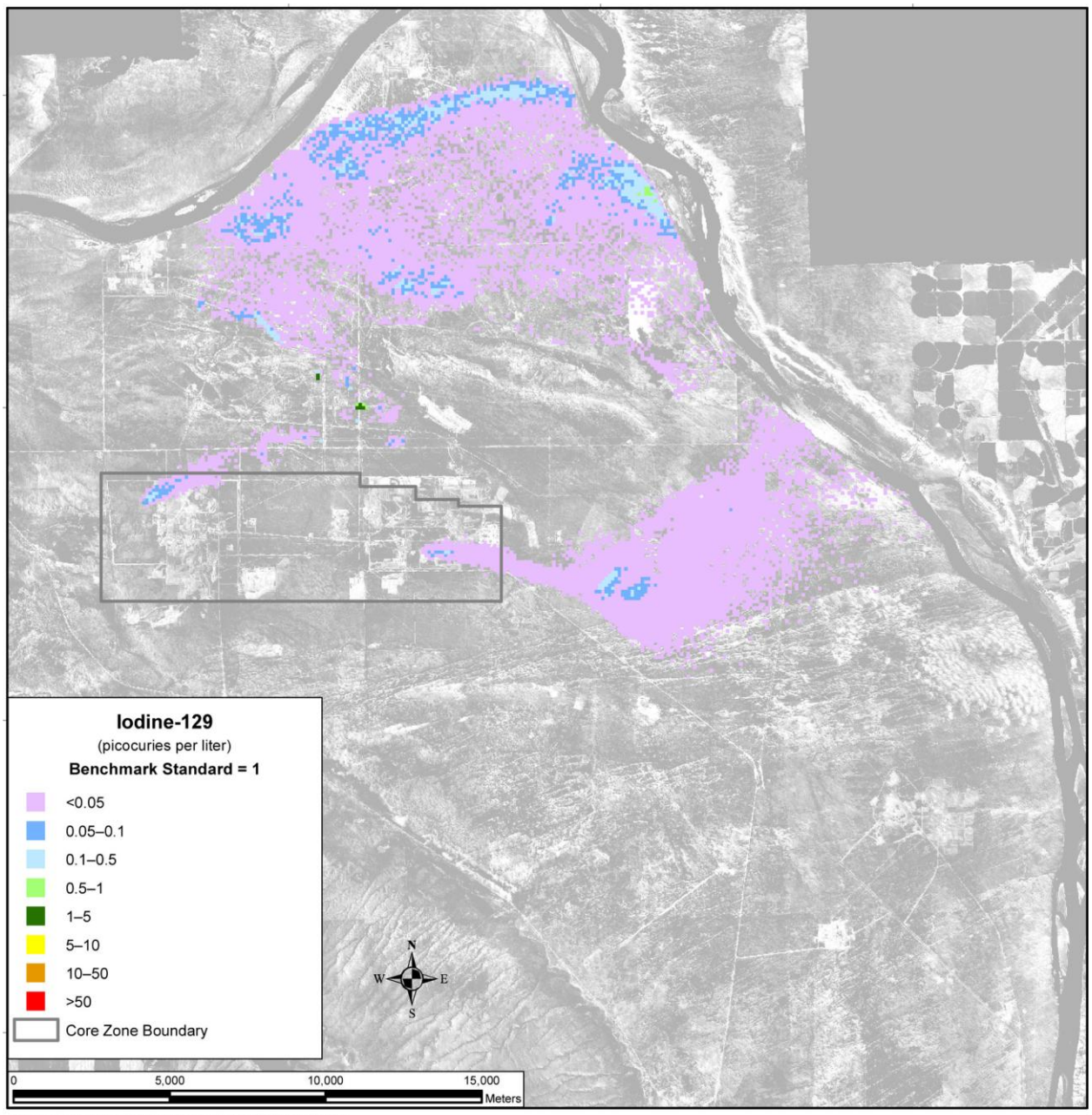
In CY 3890 (see Figure 5–806), there is a high-concentration plume of iodine-129 stretching northeast of IDF-West and a low-concentration plume stretching north from the RPPDF and through Gable Gap. Four separate high-concentration areas have also formed north of Gable Mountain and Gable Butte by CY 3890. By CY 7140 (see Figure 5–807), the plumes from IDF-West and the RPPDF have dissipated, but a new plume has formed, traveling east from IDF-East. Concentrations in this plume remain close to the benchmark. Figure 5–808 shows concentration distributions in CY 11,885. Technetium-99 (see Figures 5–809 through 5–811) shows a similar spatial distribution, but has higher concentrations in the

plume from IDF-East and lower concentrations in the plume from IDF-West. Chromium (see Figures 5–812 through 5–814) and nitrate (see Figures 5–815 through 5–817) show similar spatial distributions at selected times, but have consistently lower concentrations. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



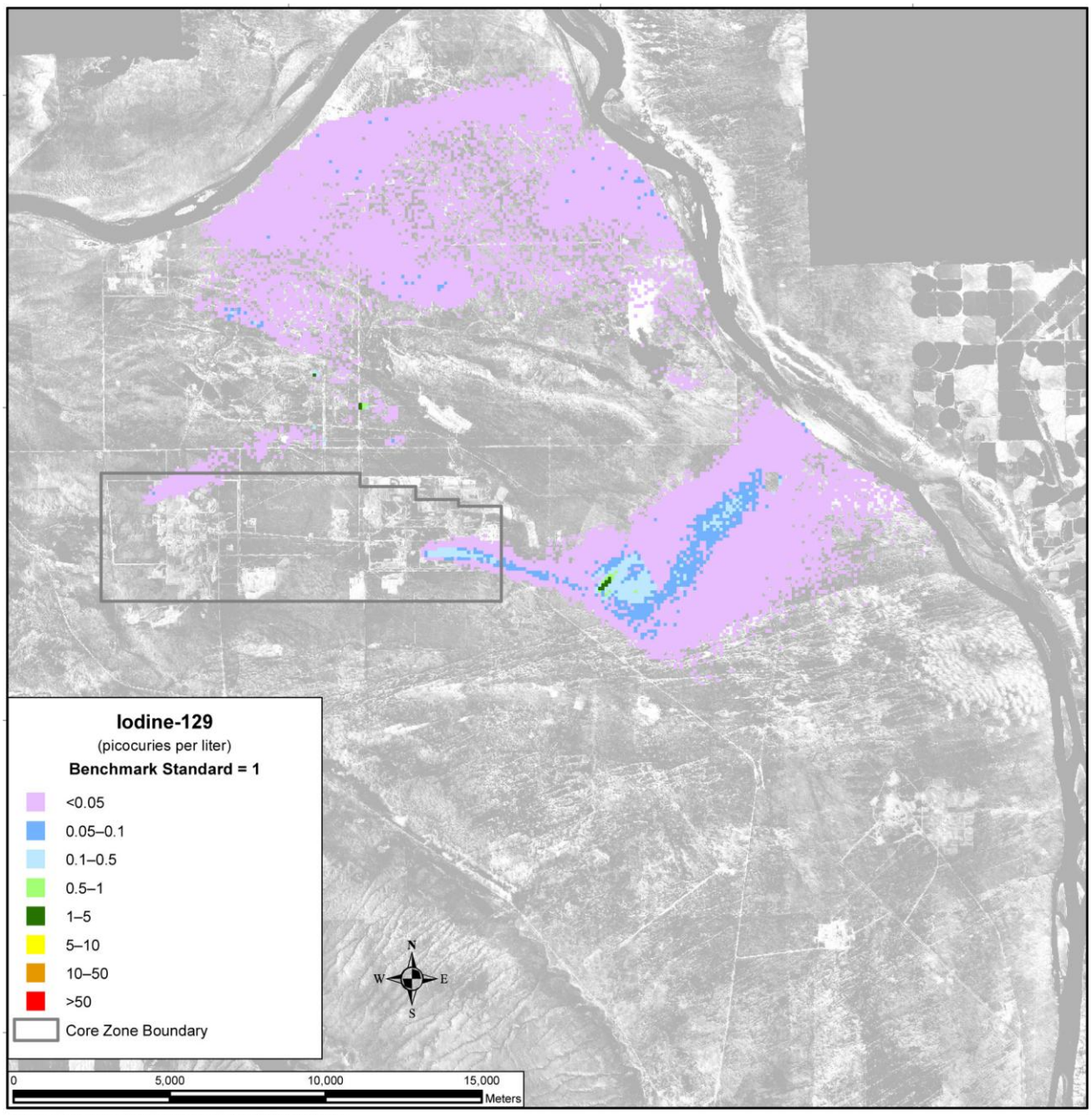
Note: To convert meters to feet, multiply by 3.281.

Figure 5–806. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



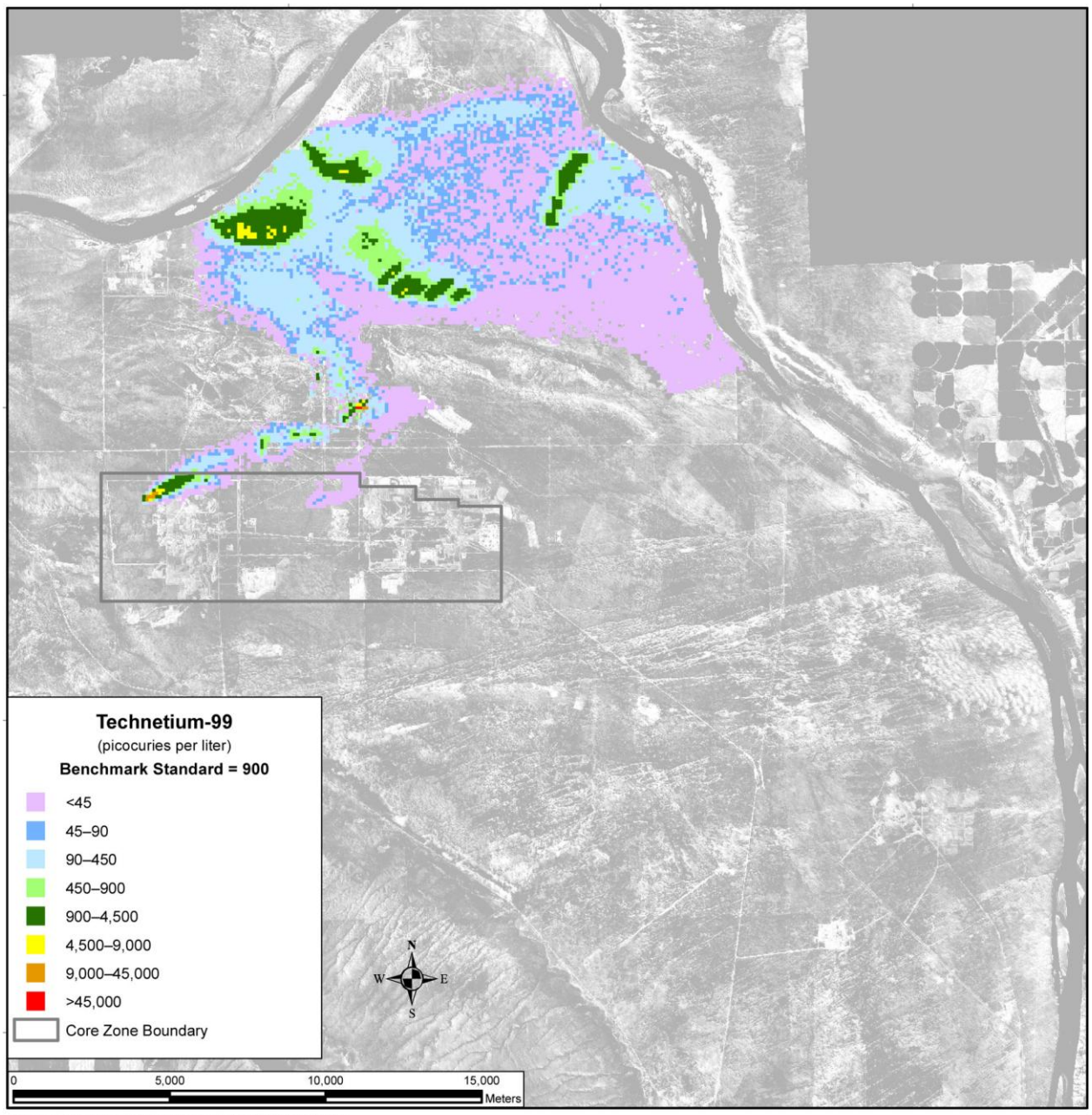
Note: To convert meters to feet, multiply by 3.281.

Figure 5–807. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



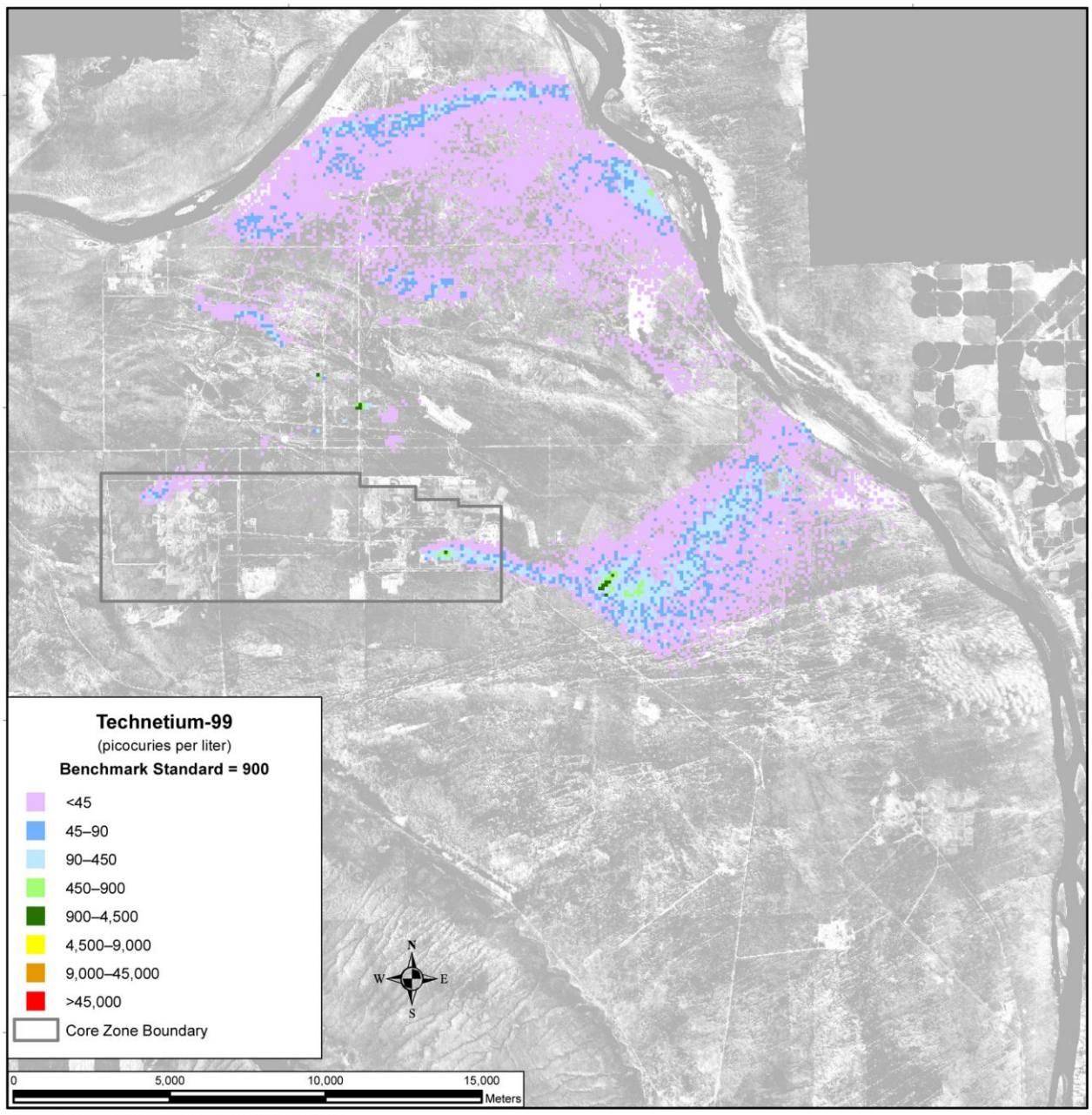
Note: To convert meters to feet, multiply by 3.281.

Figure 5–808. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



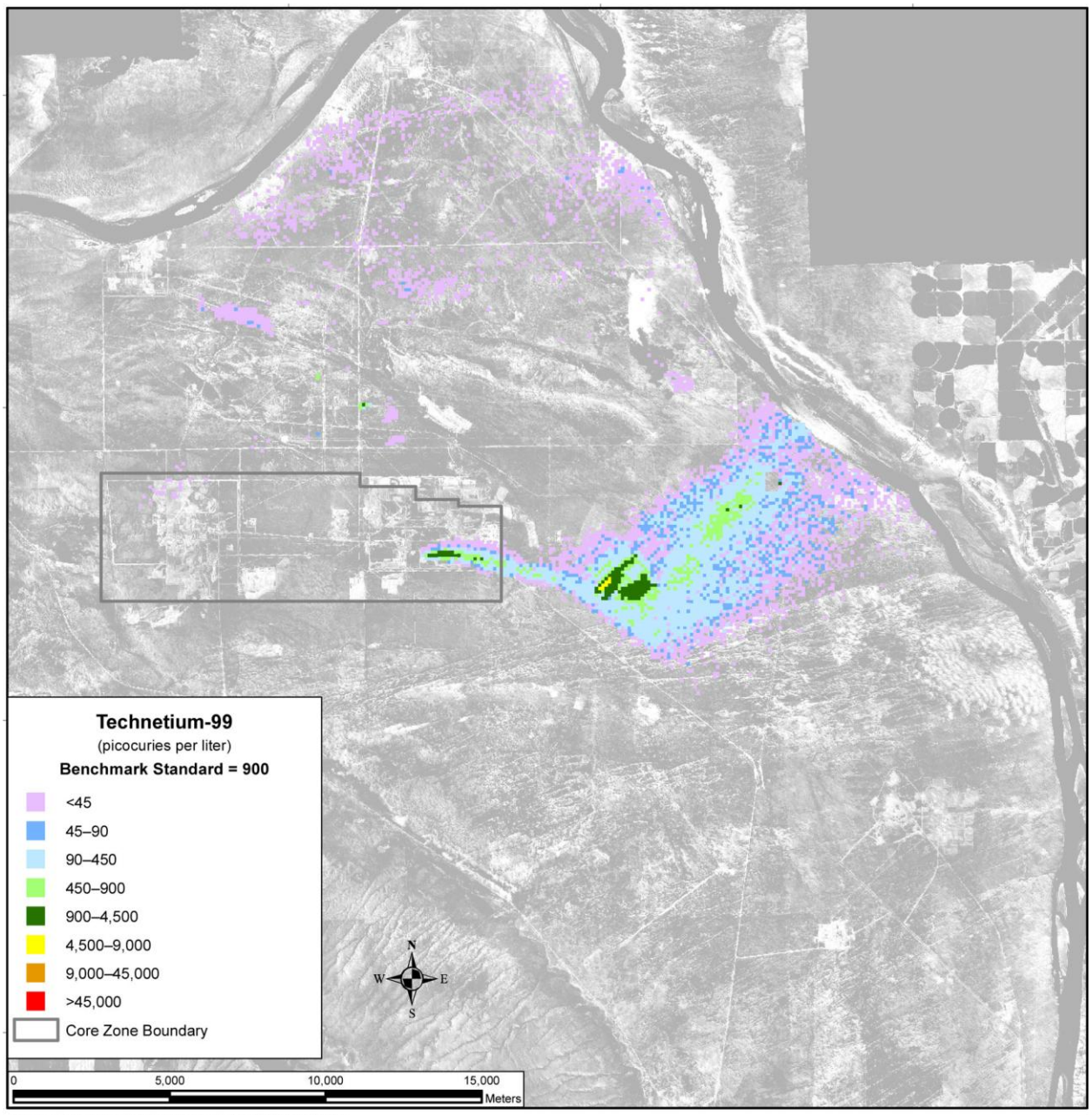
Note: To convert meters to feet, multiply by 3.281.

Figure 5–809. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



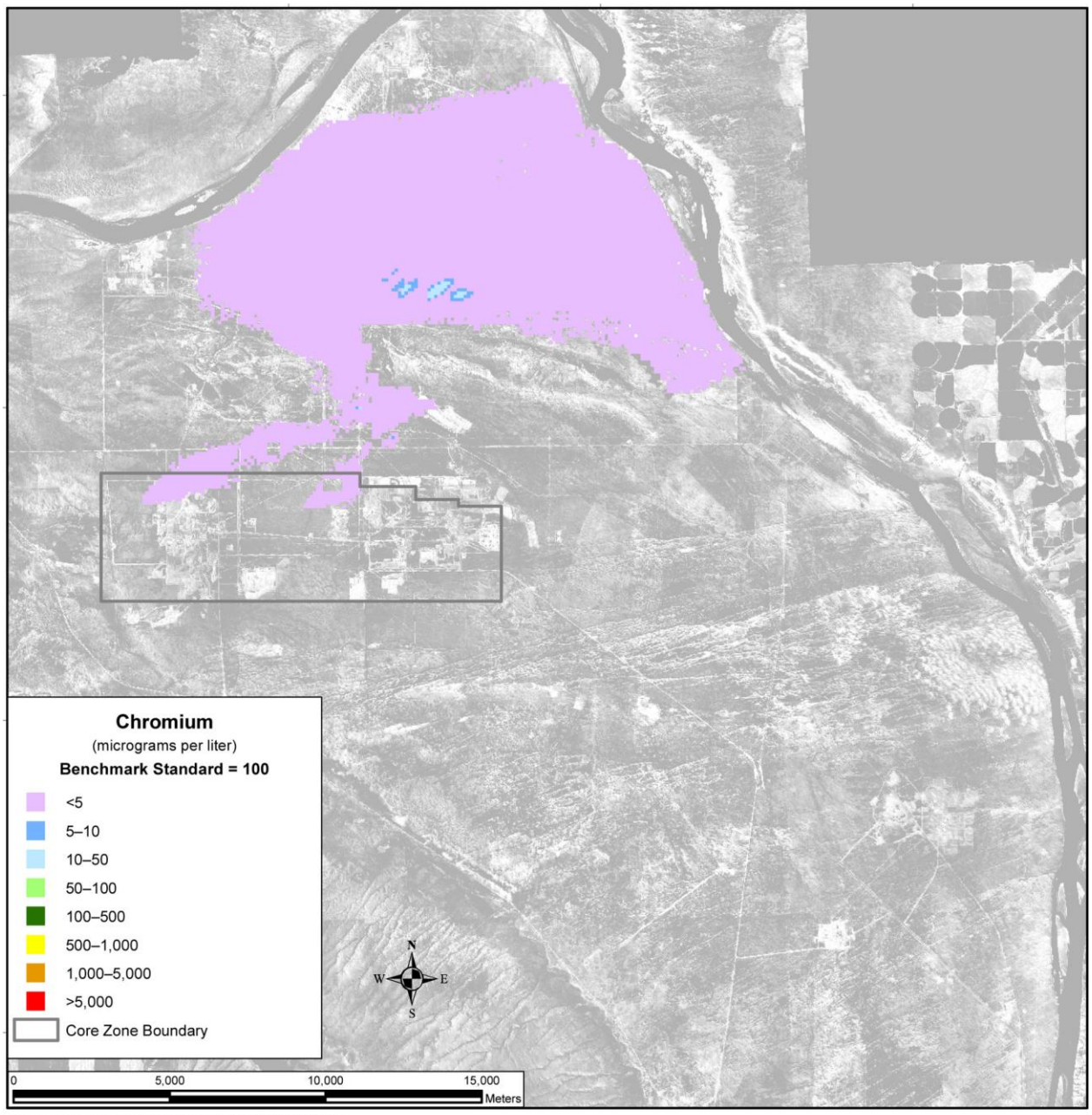
Note: To convert meters to feet, multiply by 3.281.

Figure 5–810. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



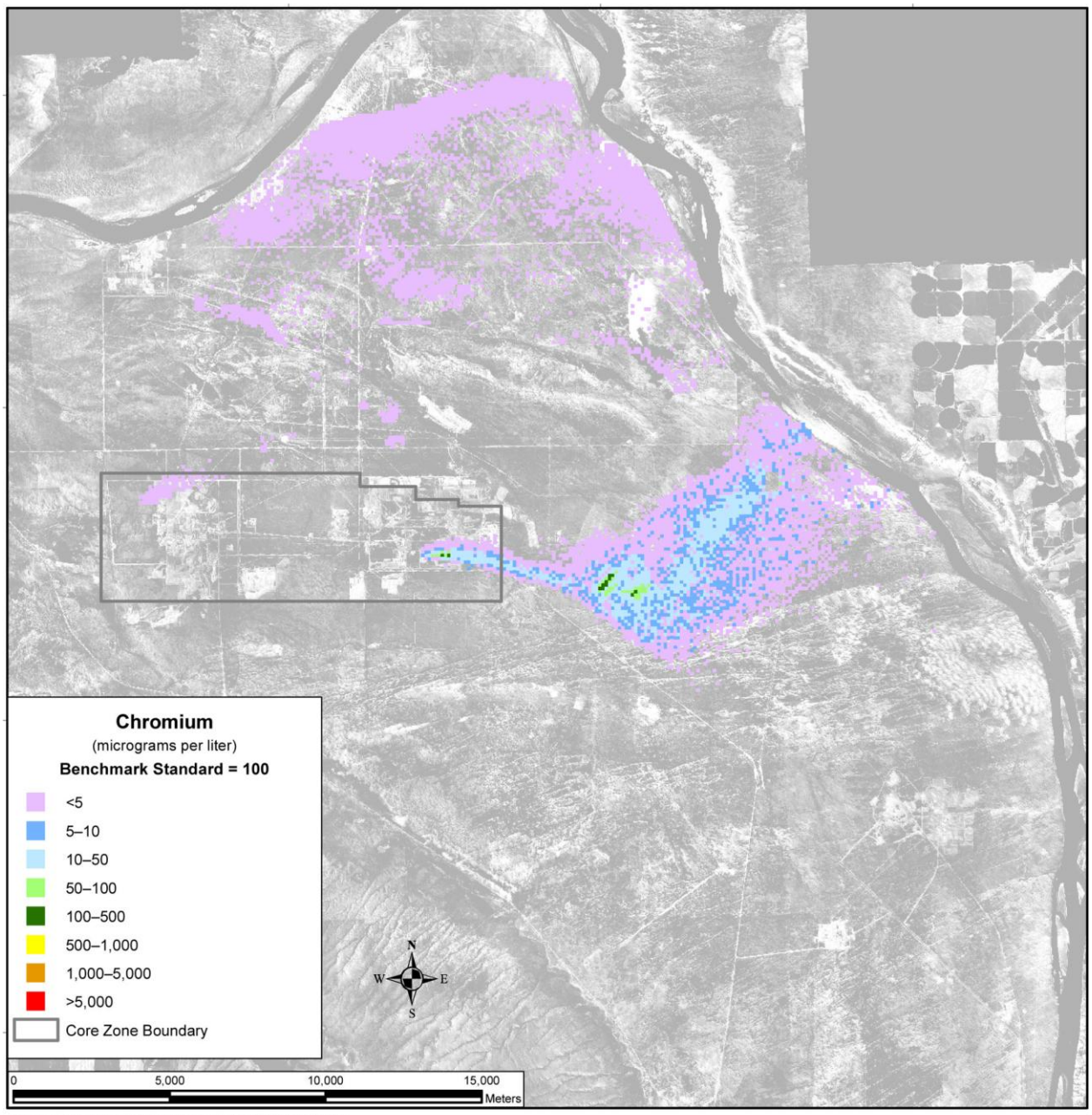
Note: To convert meters to feet, multiply by 3.281.

Figure 5–811. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



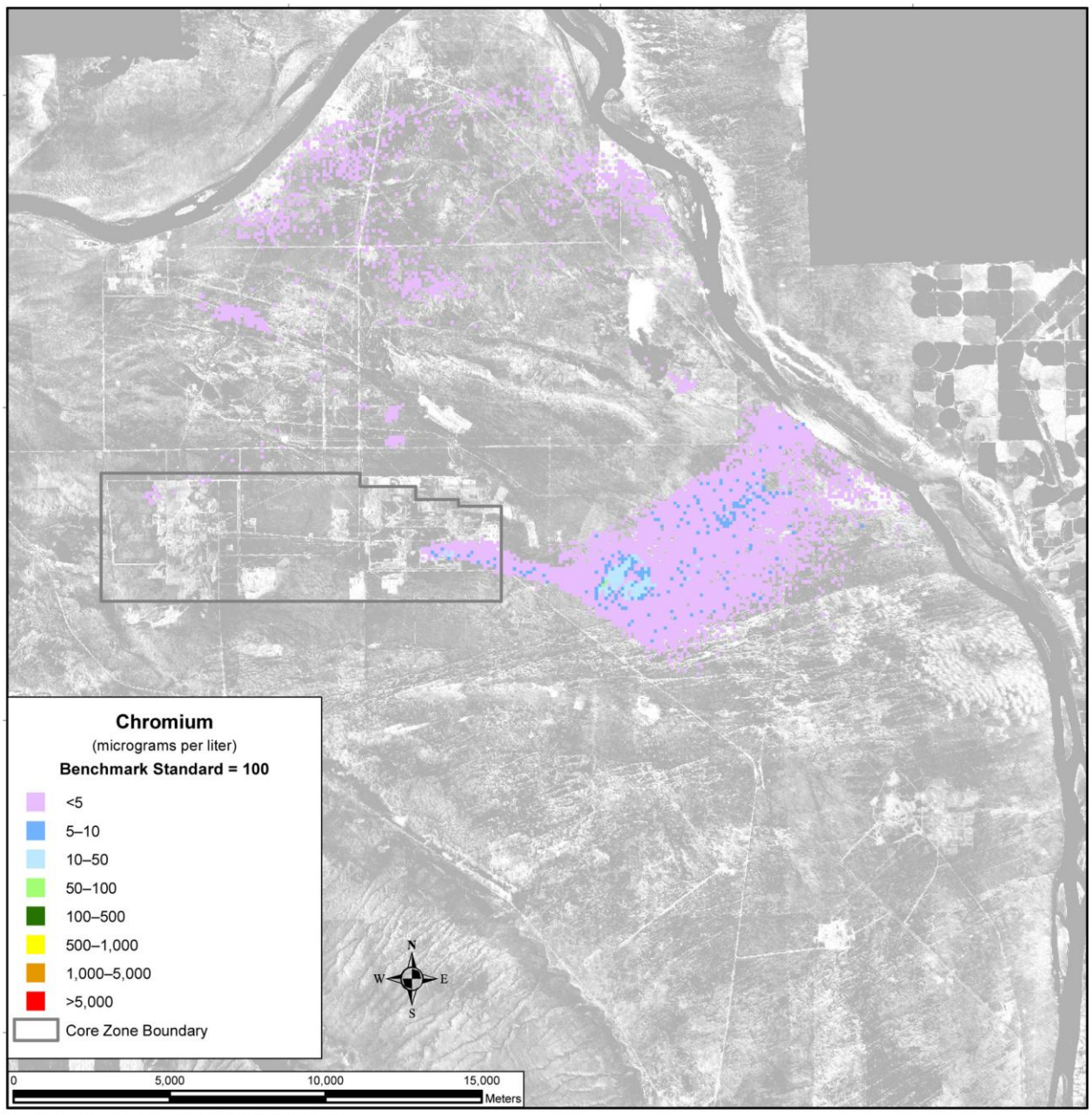
Note: To convert meters to feet, multiply by 3.281.

Figure 5–812. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



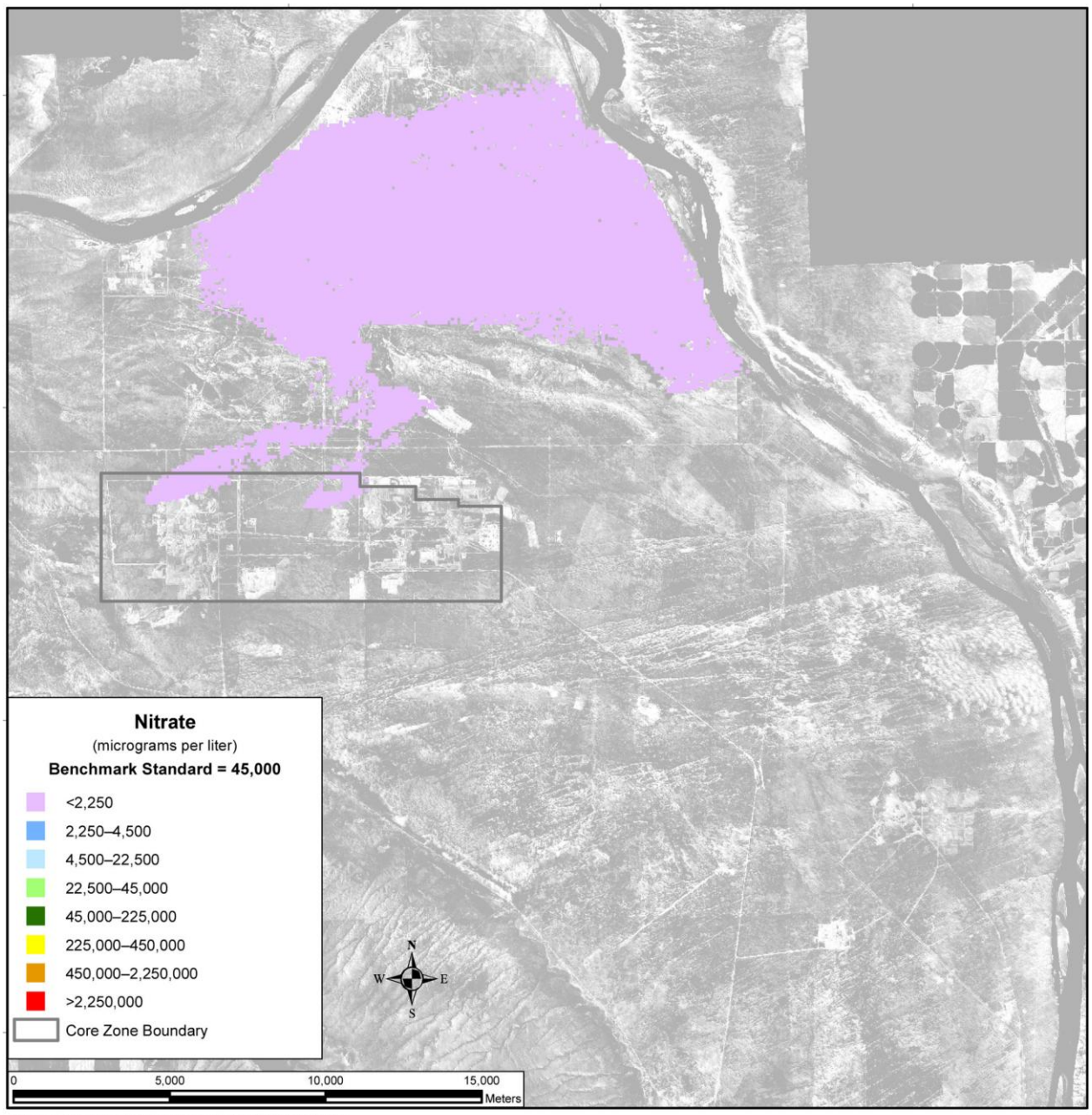
Note: To convert meters to feet, multiply by 3.281.

Figure 5–813. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



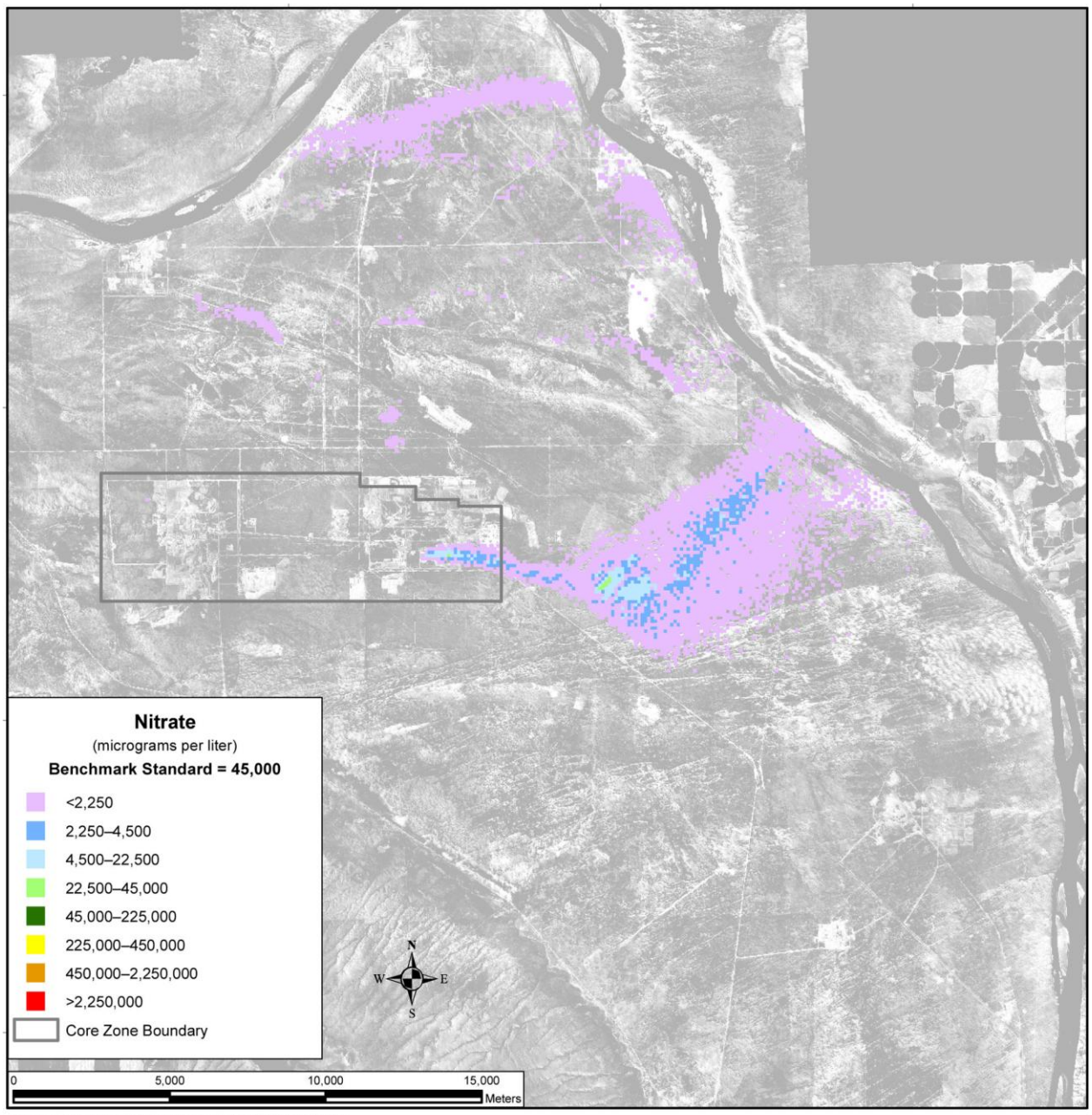
Note: To convert meters to feet, multiply by 3.281.

Figure 5–814. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



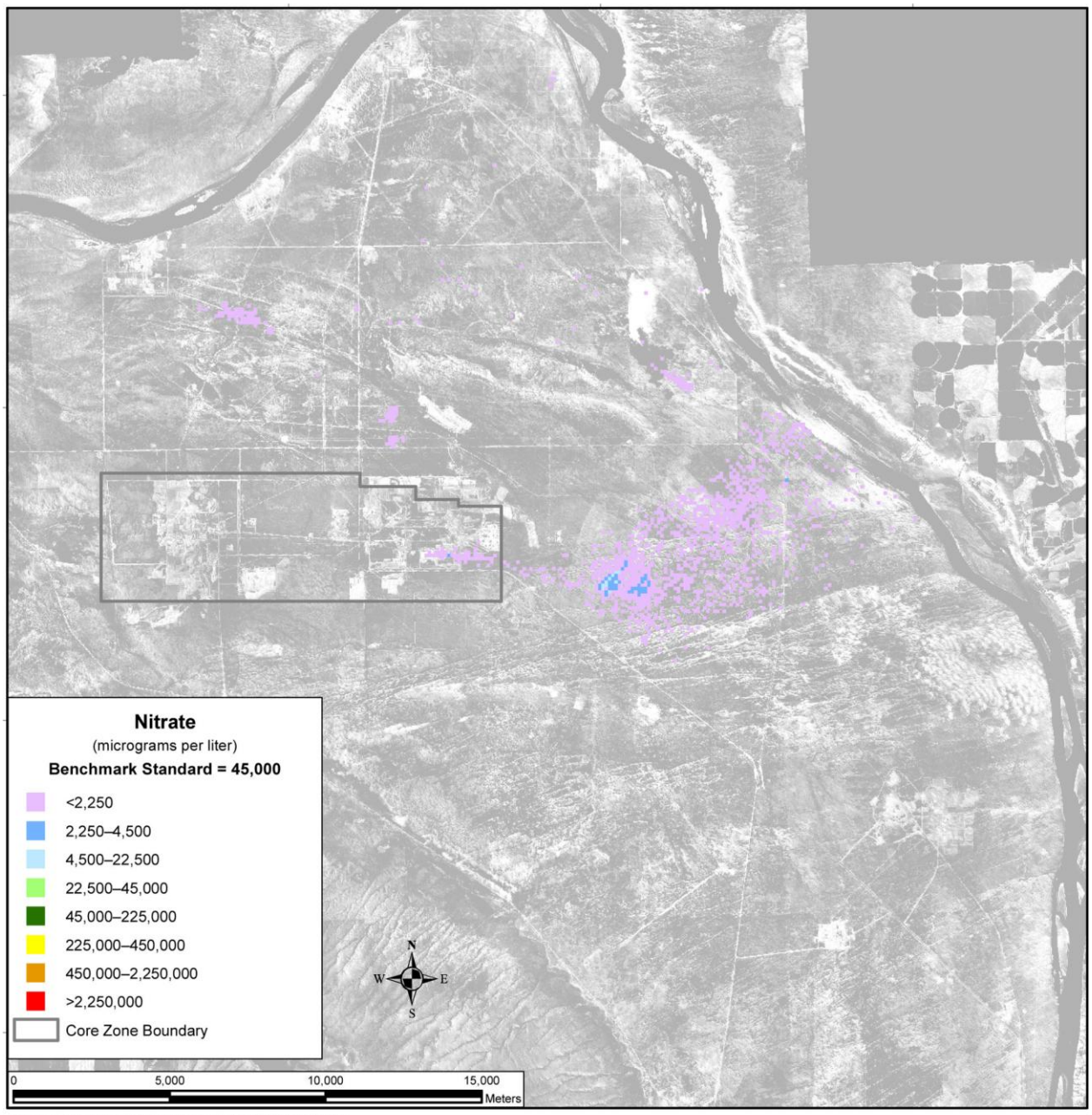
Note: To convert meters to feet, multiply by 3.281.

Figure 5–815. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–816. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–817. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in general, discharges from IDF-East and IDF-West are the predominant contributors. Discharges from the RPPDF are secondary contributors.

Concentrations of iodine-129 and technetium-99 show a sharp rise and fall between CY 2940 and CY 4940 that exceed the benchmark by an order of magnitude or slightly more. Chromium and nitrate show a similar rise and fall, but both remain below their respective benchmarks. For all of the conservative tracers, concentrations at the Core Zone Boundary remain within an order of magnitude of

the benchmark concentration during the last 5,000 years of the period of analysis. Concentrations at the Columbia River nearshore are slightly lower, but within an order of magnitude of the concentrations at the Core Zone Boundary. The intensities and areas of these groundwater plumes stabilize around CY 6940.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of total uranium remain seven orders of magnitude below the benchmark at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore for the duration of the 10,000-year simulation period. The intensity is highest and the area of the contamination plumes largest near the end of the period of analysis.

5.3.1.3.1.4 Disposal Group 1, Subgroup 1-D

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Summaries of the proposed actions and timelines for Waste Management Alternative 3 are provided in Chapter 2, Section 2.5.

Five subtotals are plotted in Figures 5–818 through 5–823, representing releases from IDF-East, which include ILAW glass, steam reforming waste, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, as follows:

- The disposal period was assumed to start with the onset of disposal operations for IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially

100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–818 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–819, the chemical hazard drivers. The inventories in the five waste forms are a major factor in the release quantities to the vadose zone. The predominant source of technetium-99 (96 percent) and chromium (greater than 99 percent) is steam reforming waste. The predominant sources of iodine-129 are steam reforming waste (31 percent) and ETF-generated secondary waste (69 percent). The predominant source of nitrate (greater than 99 percent) is ETF-generated secondary waste. No fluoride is released from IDF-East.

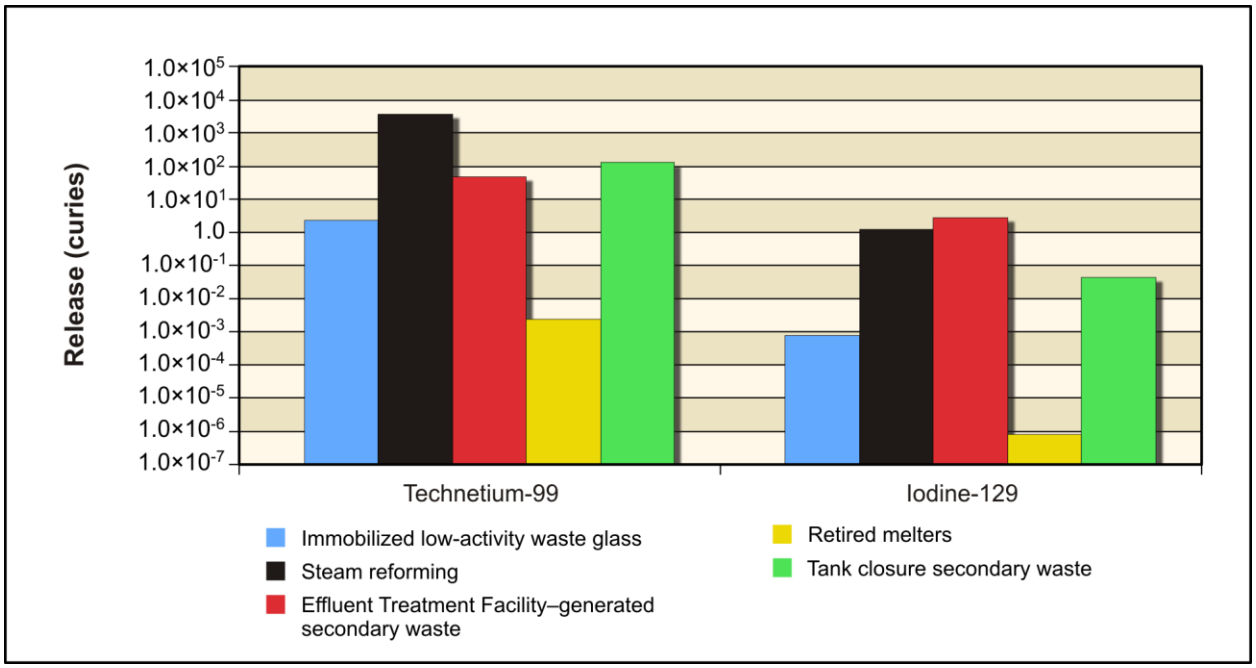


Figure 5–818. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

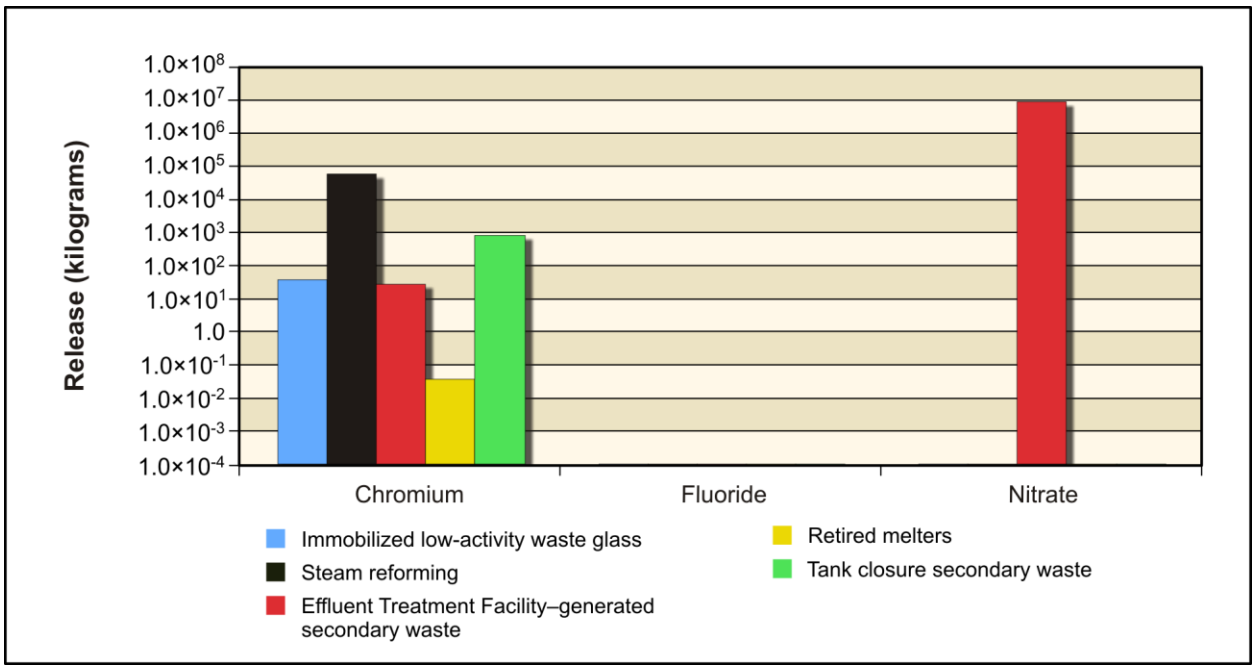


Figure 5–819. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–820 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–821, the chemical hazard drivers. In addition to the waste inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Approximately 43 percent of the vadose zone technetium-99, iodine-129, and chromium are released to groundwater during the period of analysis and essentially all (greater than 99 percent) of the nitrate.

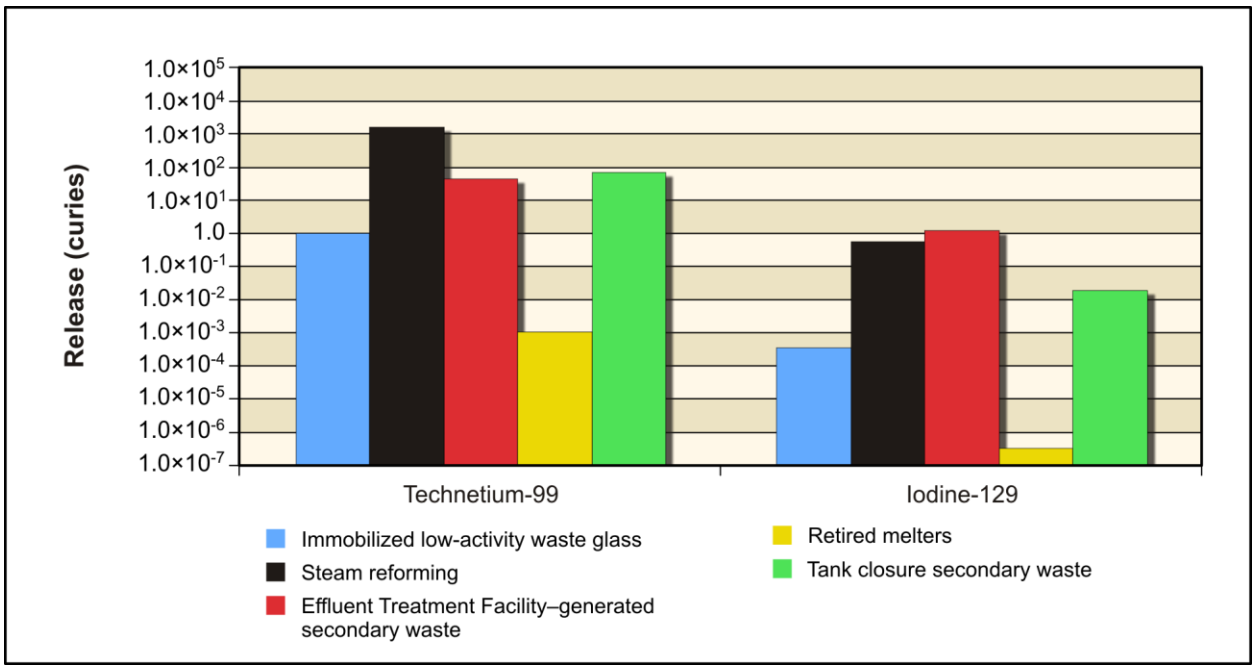


Figure 5–820. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

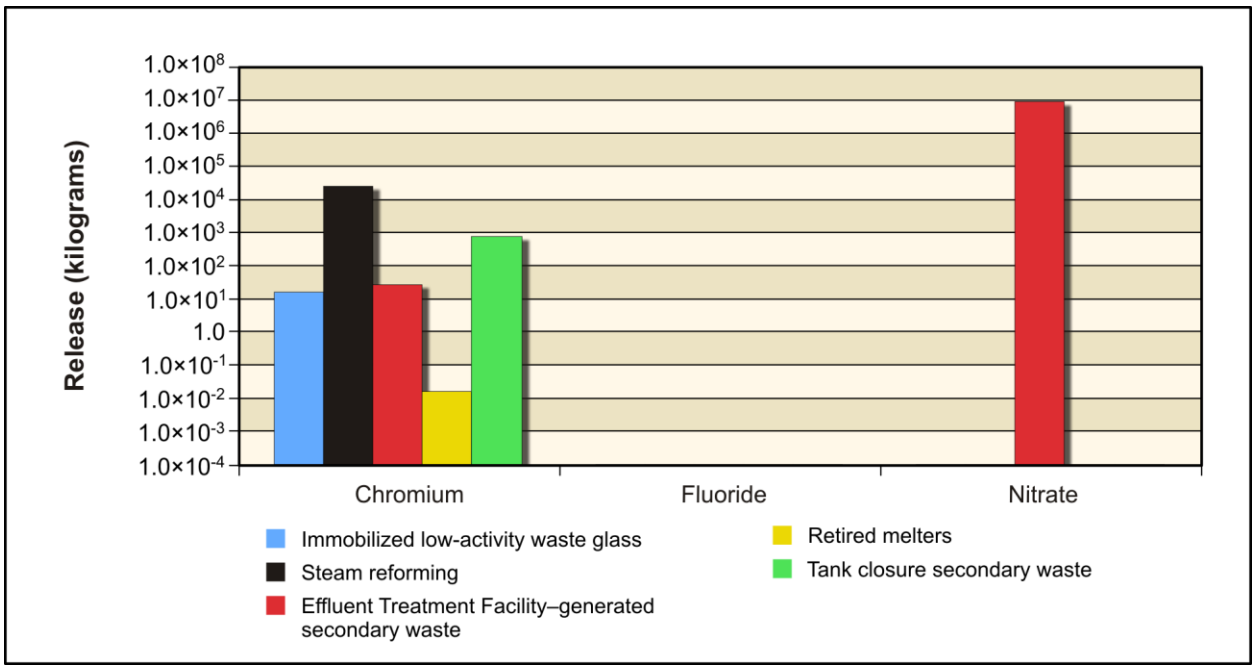


Figure 5–821. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–822 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–823, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the groundwater technetium-99 (97 percent), iodine-129 (96 percent), chromium (96 percent), and nitrate (99 percent) are released to the Columbia River.

Overall, approximately 42 percent of the IDF-East vadose zone technetium-99, iodine-129, and chromium reaches the Columbia River during the period of analysis. For nitrate, greater than 99 percent of the vadose zone release reaches the Columbia River.

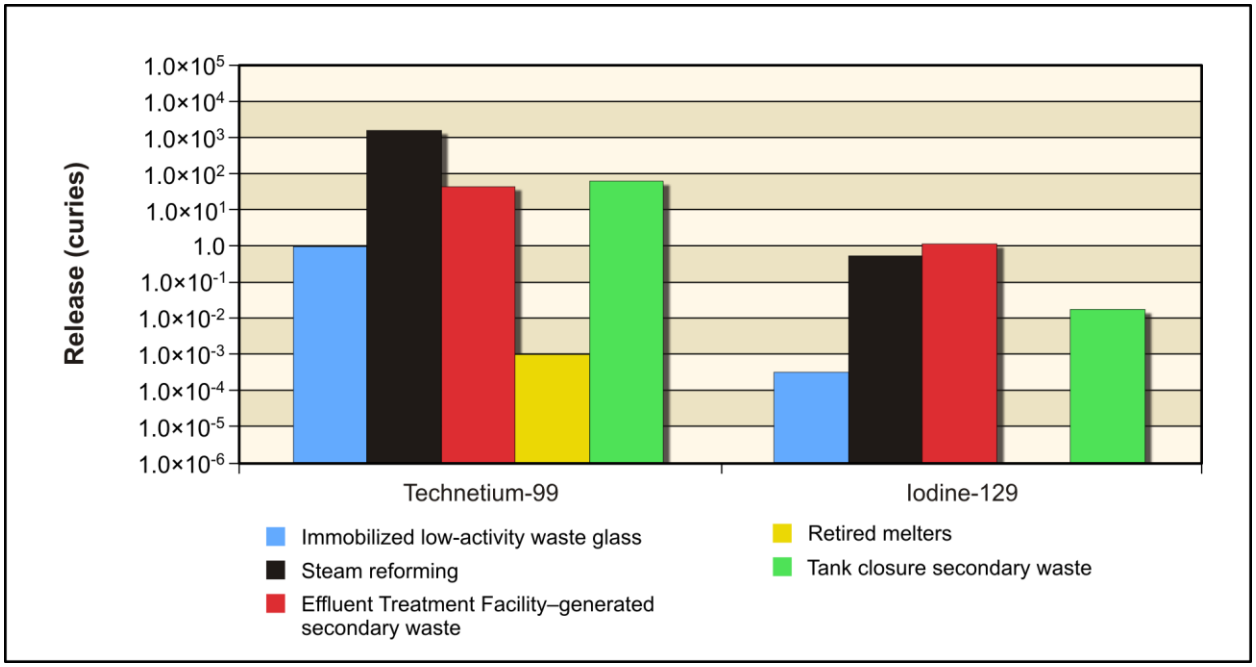


Figure 5–822. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

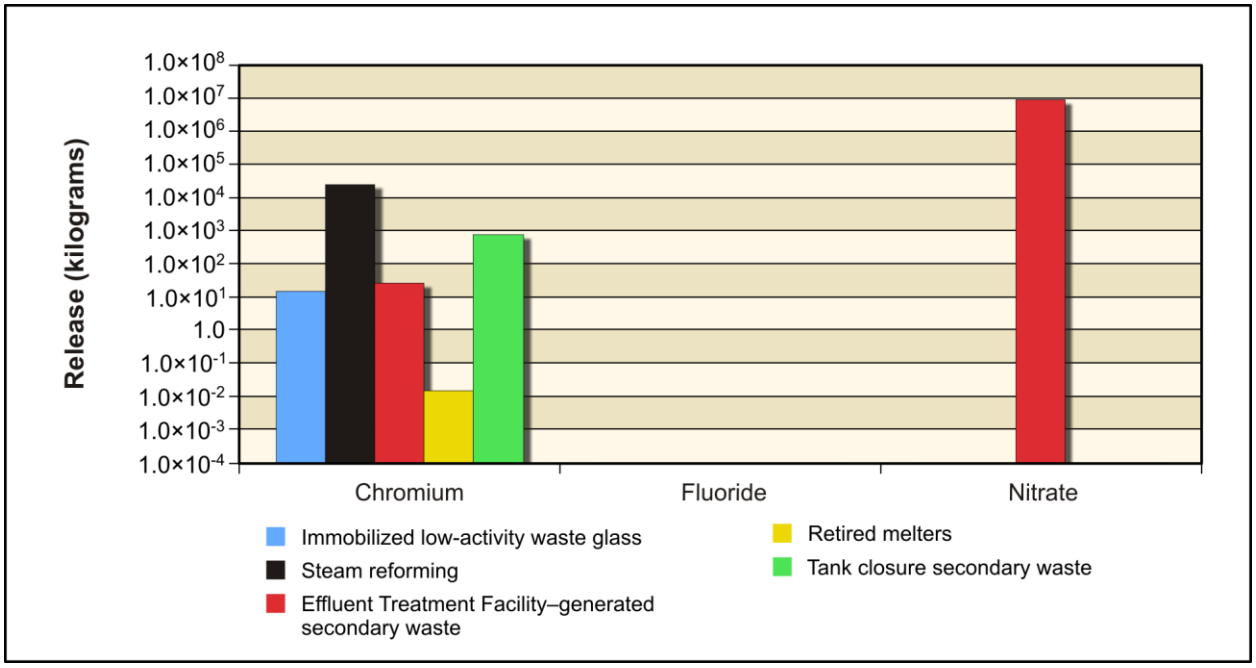


Figure 5–823. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–824 through 5–829, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–824 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–825, the chemical hazard drivers. The inventories in the three waste forms are a major factor in the release quantities to the vadose zone. The predominant source of technetium-99 (greater than 99 percent) and iodine-129 (greater than 99 percent) is offsite waste released to the vadose zone. All (greater than 99 percent) of the nitrate and fluoride released to the vadose zone are from waste management secondary waste and onsite waste. The chromium released to the vadose zone is from waste management secondary waste and onsite waste (69 percent) and offsite waste (31 percent). FFTF Decommissioning Alternative 3 waste contributes less than 1 percent of the total release.

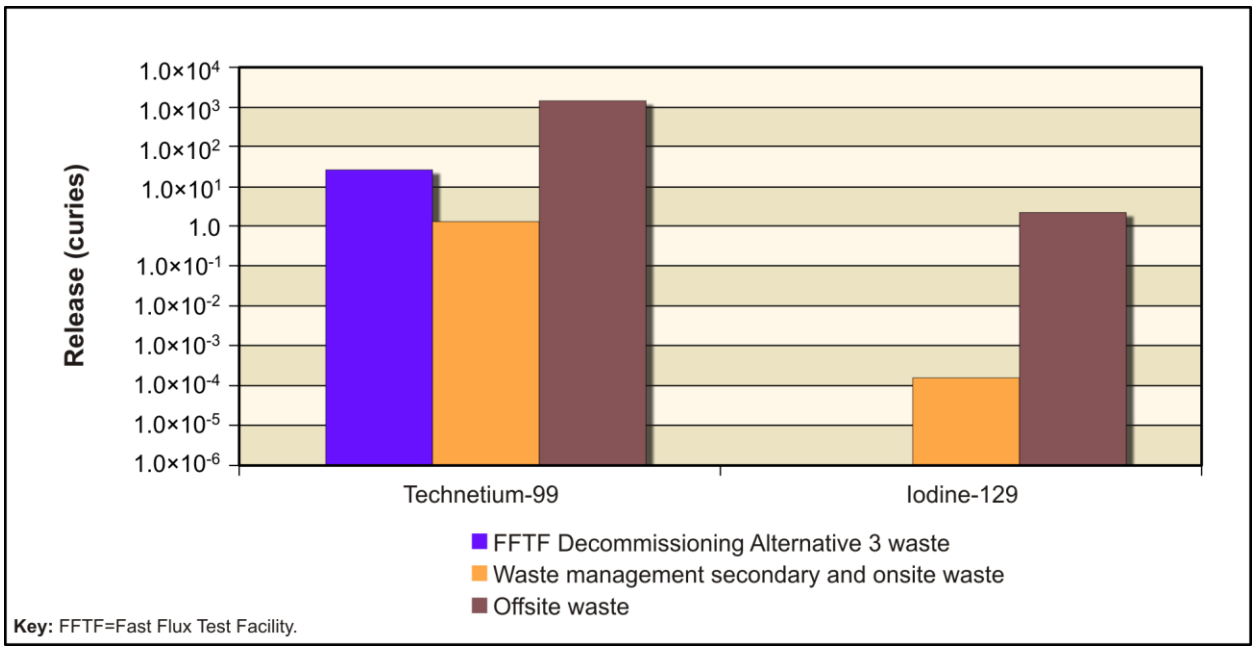


Figure 5–824. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

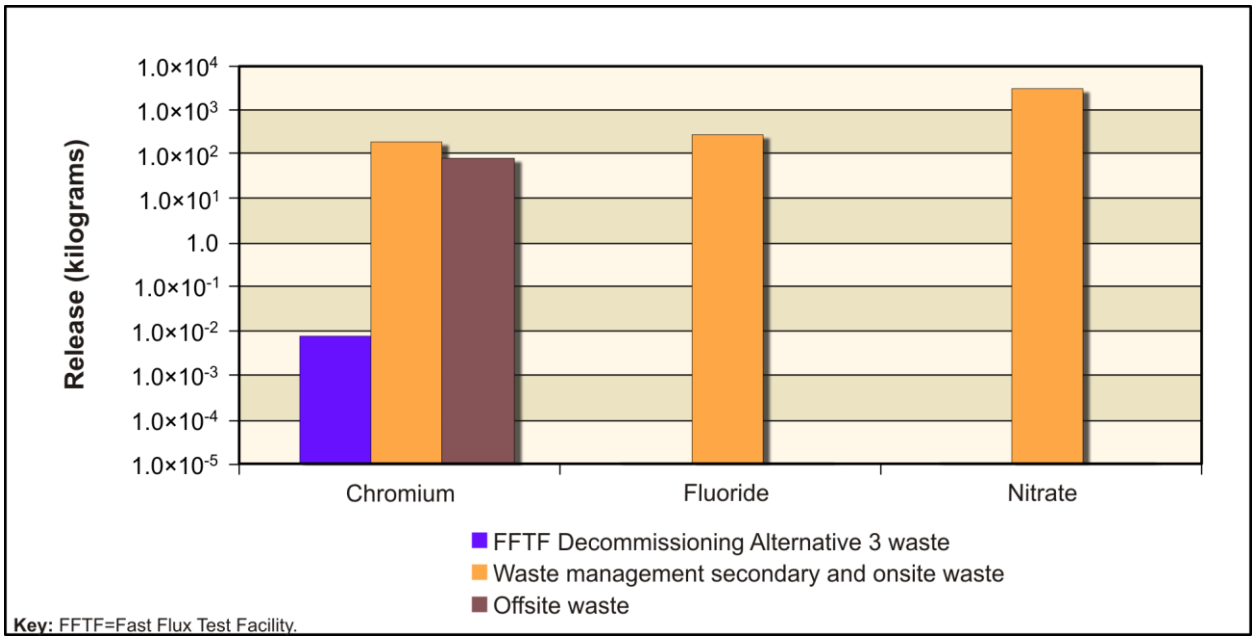


Figure 5–825. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–826 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–827, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Almost all of the vadose zone technetium-99 (98 percent), iodine-129 (97 percent), chromium (99 percent), nitrate (greater than 99 percent), and fluoride (greater than 99 percent) are released to groundwater during the period of analysis.

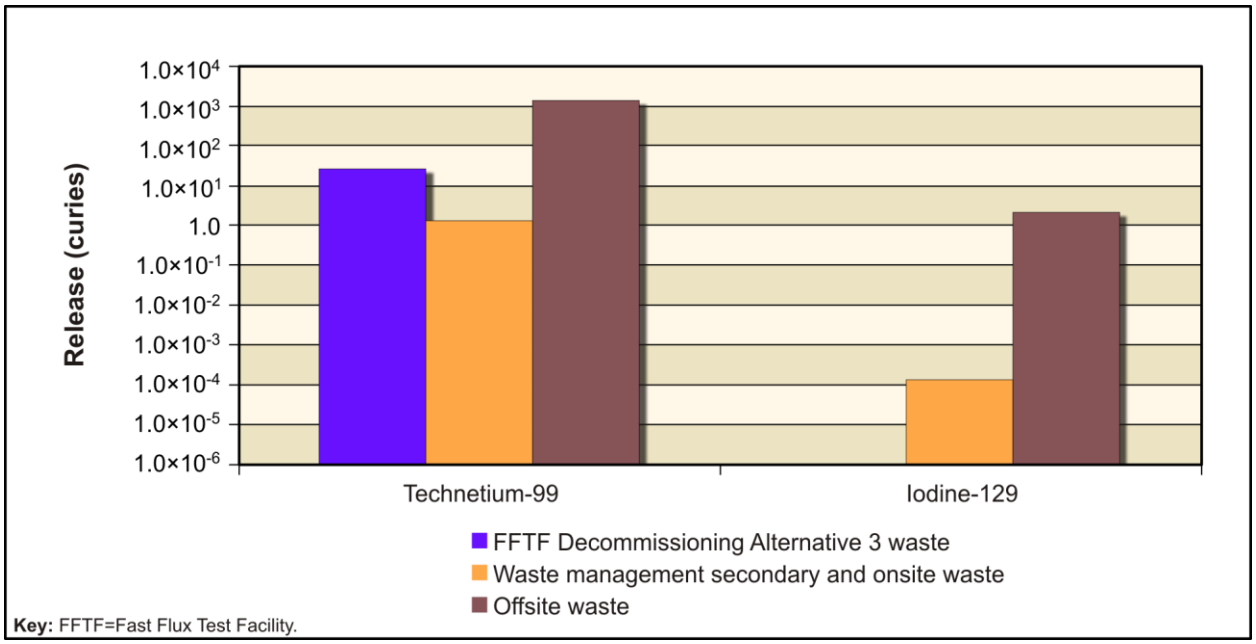


Figure 5–826. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

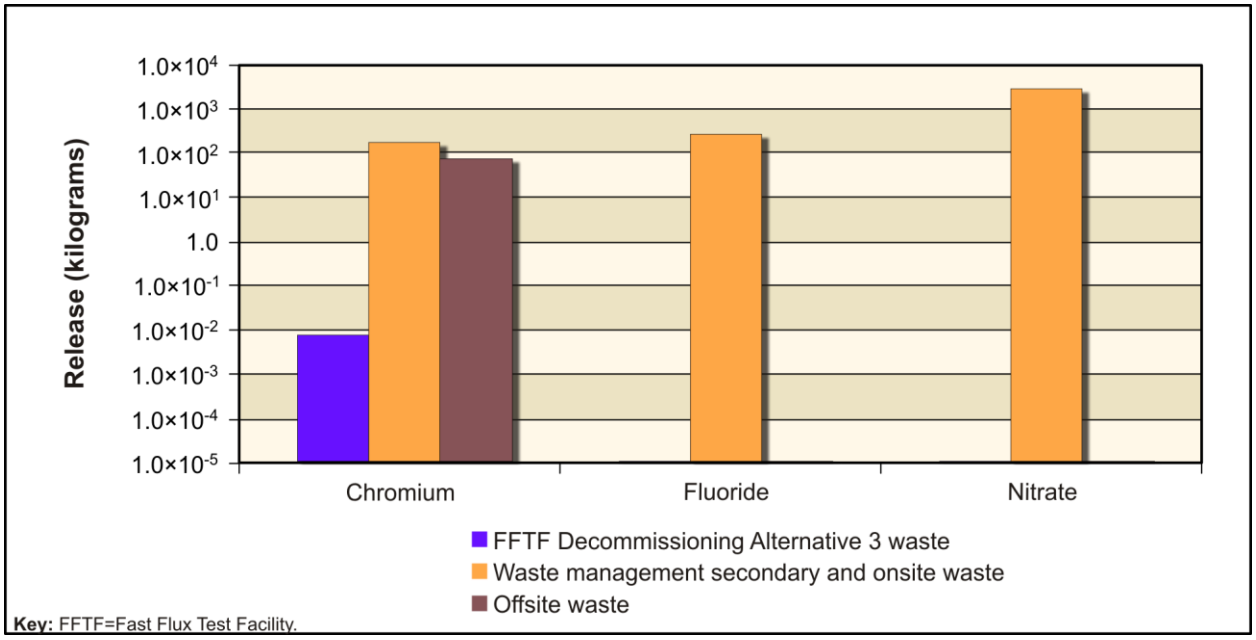


Figure 5–827. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–828 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–829, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Most (greater than 99 percent) of the IDF-West groundwater technetium-99, iodine-129, chromium, nitrate, and fluoride are released to the Columbia River over the period of analysis.

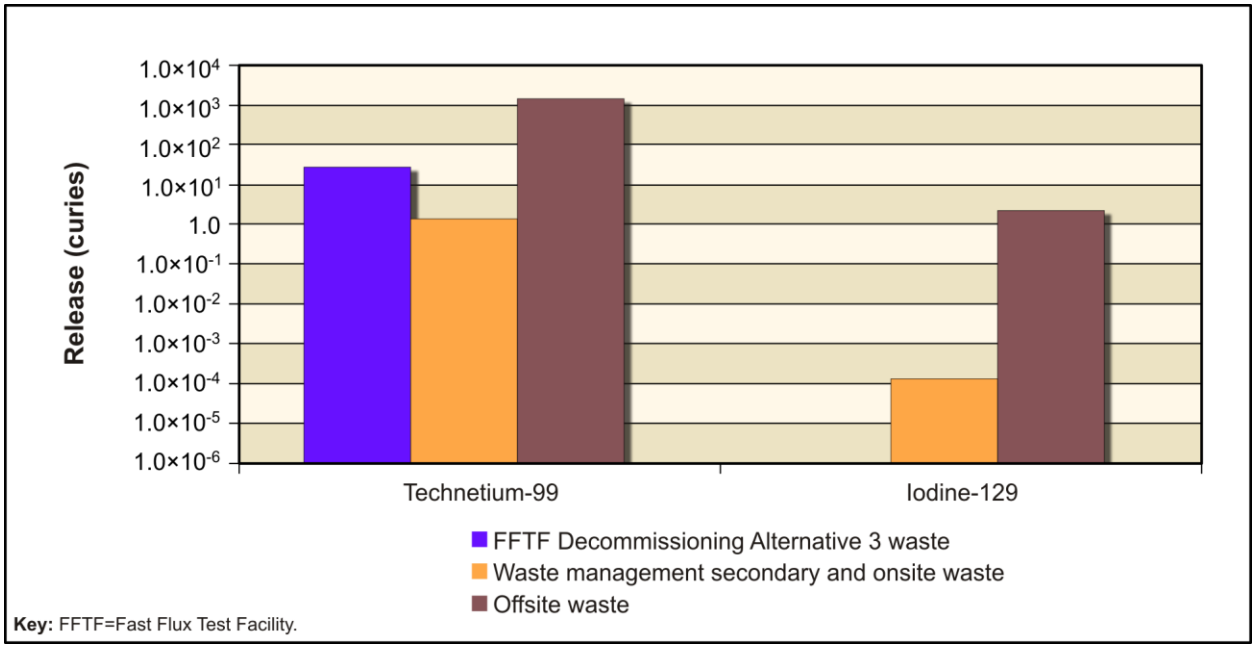


Figure 5–828. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

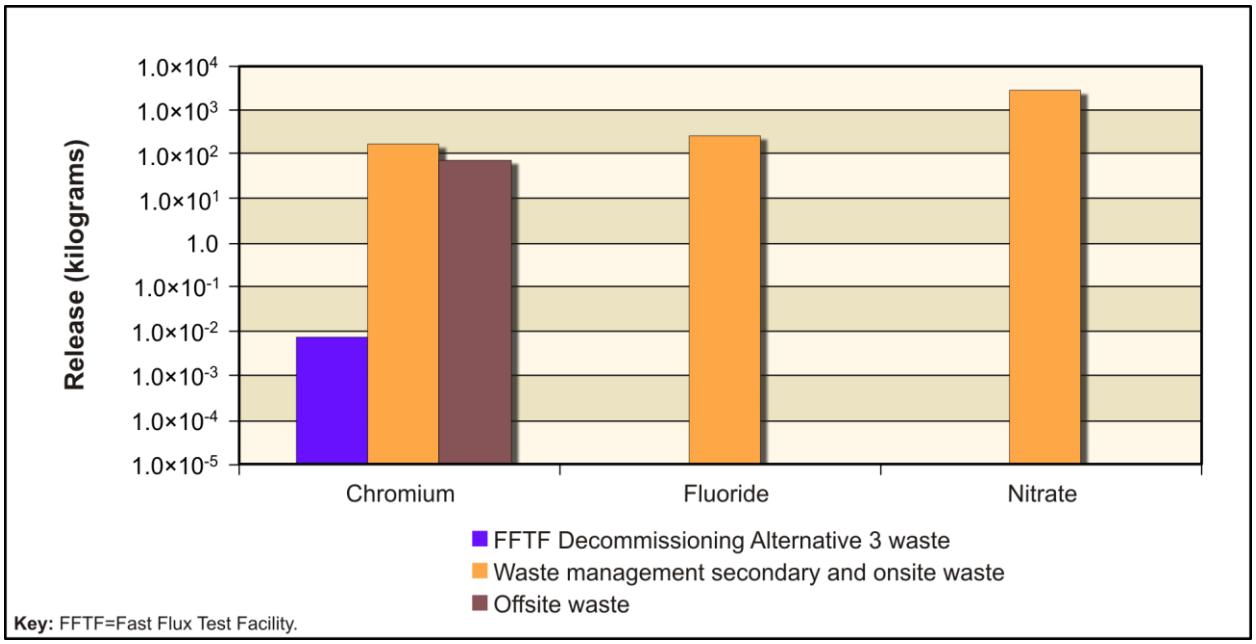


Figure 5–829. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

Overall, almost all (97–99 percent) of the IDF-West vadose zone technetium-99, iodine-129, chromium, nitrate, and fluoride reach the Columbia River over the period of analysis.

River Protection Project Disposal Facility

Figure 5–830 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–831, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). No fluoride is released from the RPPDF.

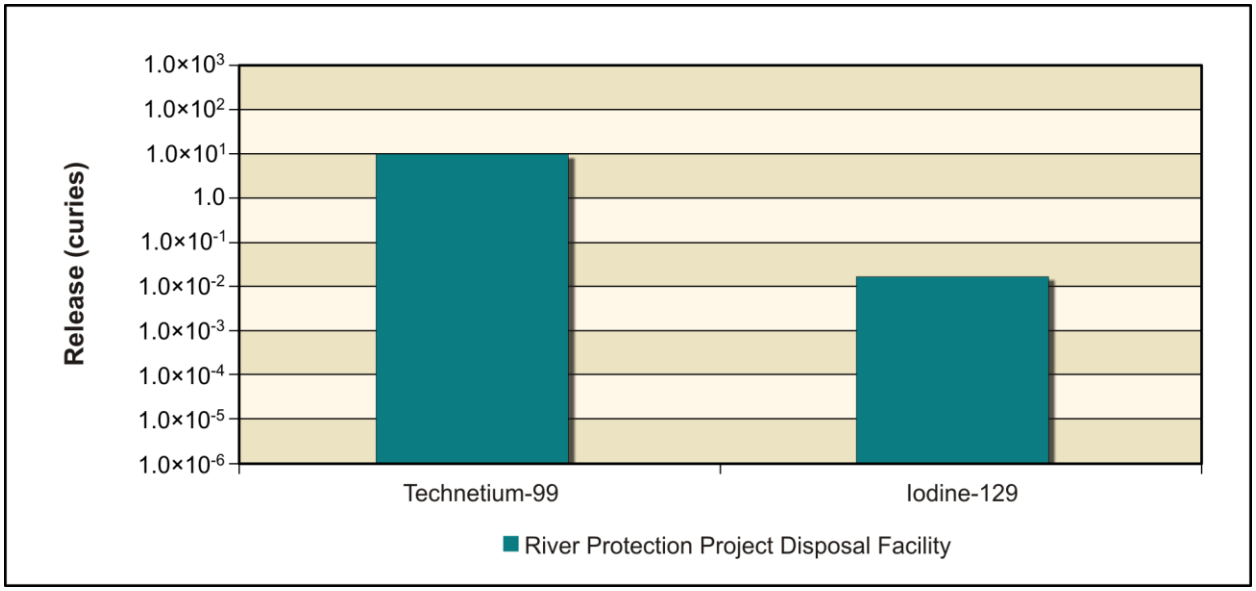


Figure 5–830. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

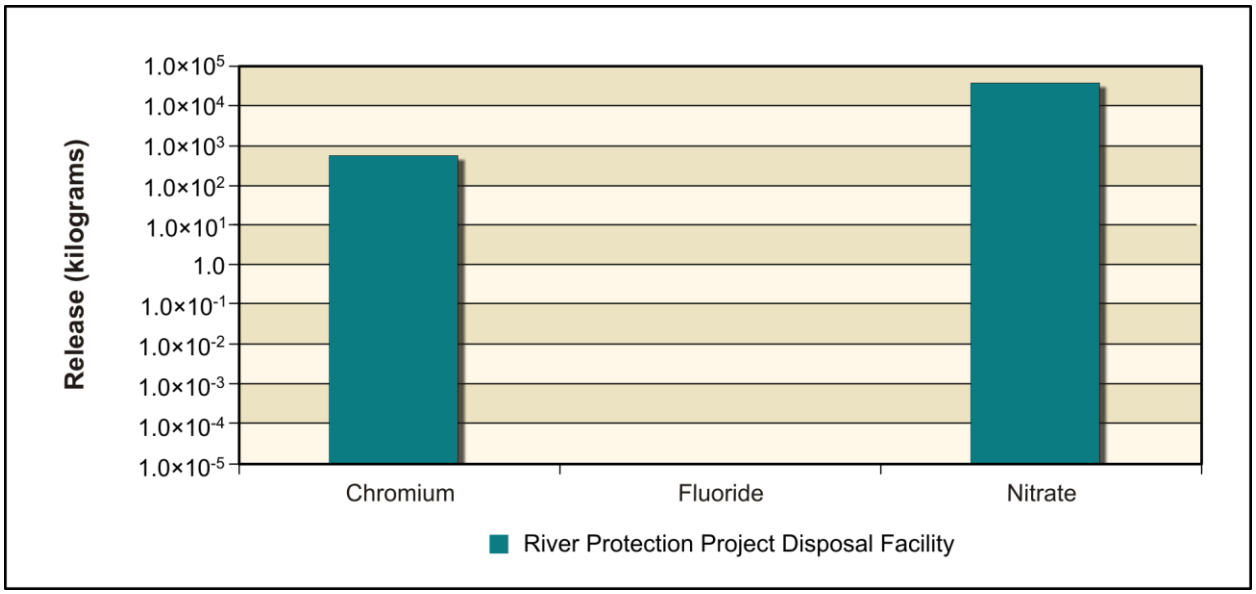


Figure 5–831. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–832 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–833, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Essentially all (greater than 99 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate are released to groundwater.

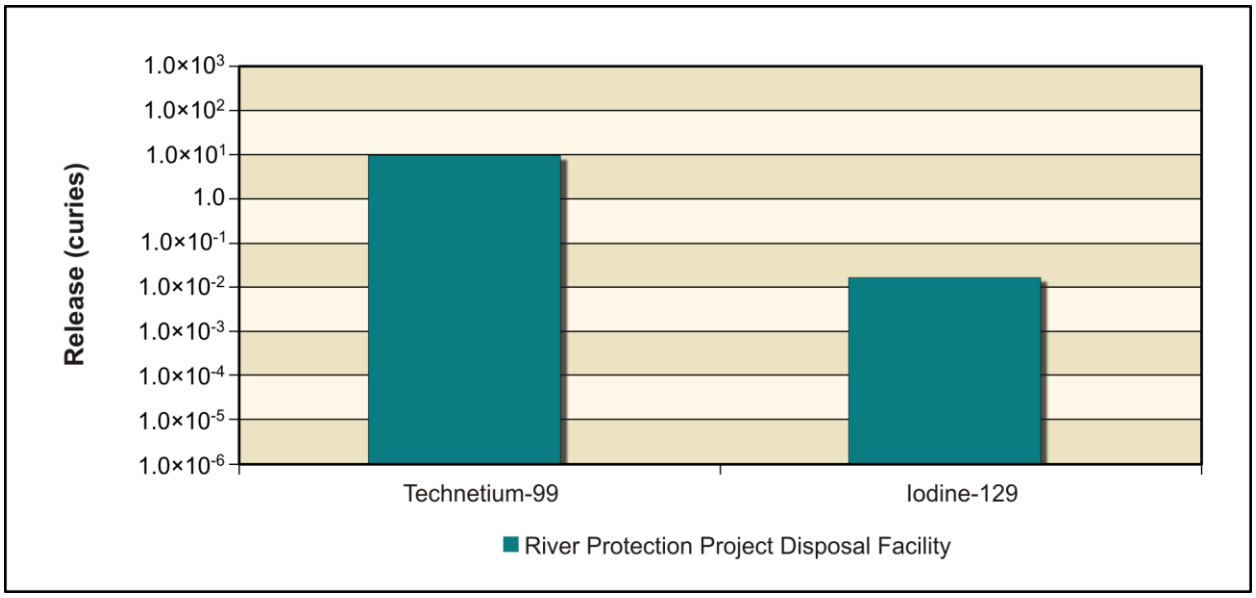


Figure 5–832. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

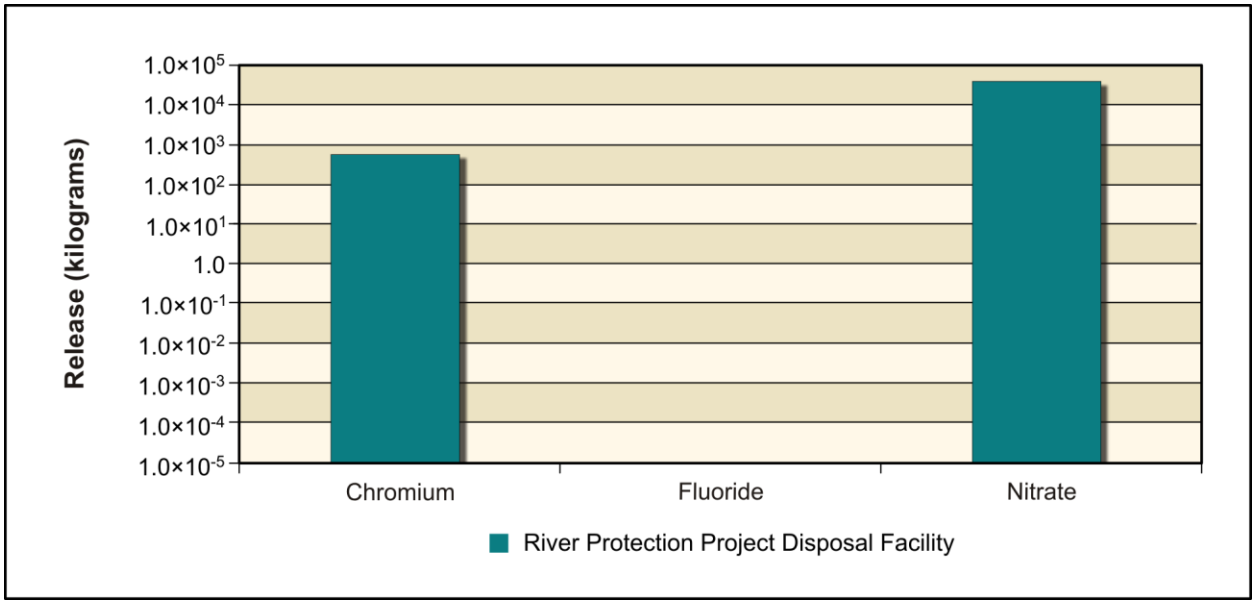


Figure 5–833. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–834 shows the estimated RPPDF release from groundwater to the Columbia River of the radiological risk drivers and Figure 5–835, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Most (greater than 99 percent) of the groundwater technetium-99, iodine-129, chromium, and nitrate are released to the Columbia River.

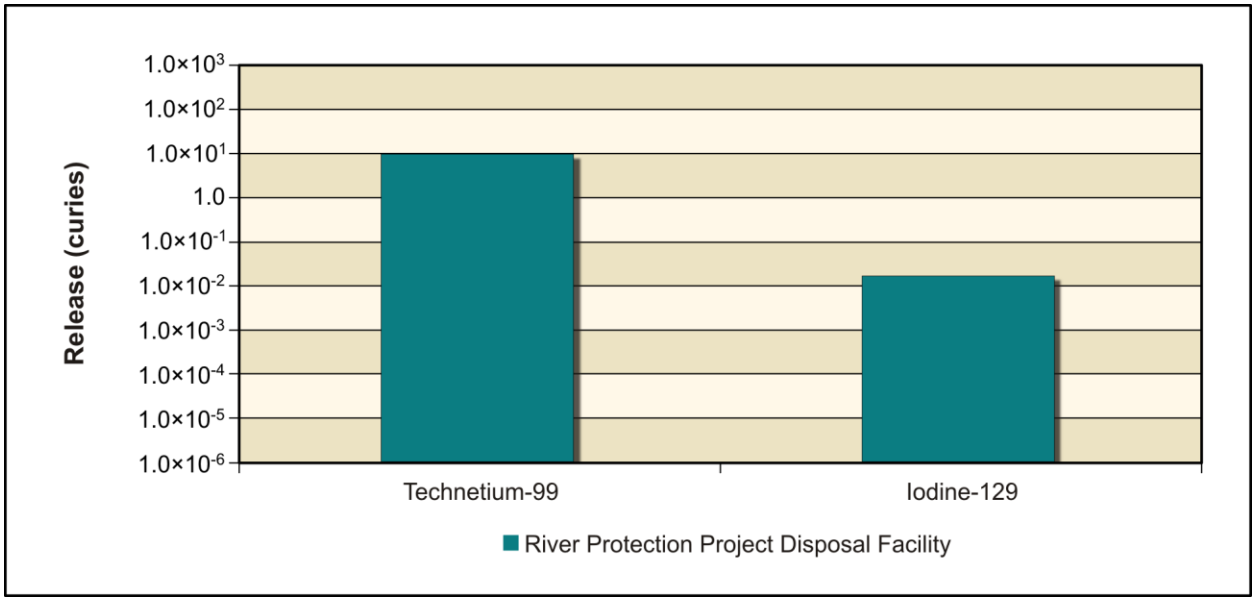


Figure 5–834. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

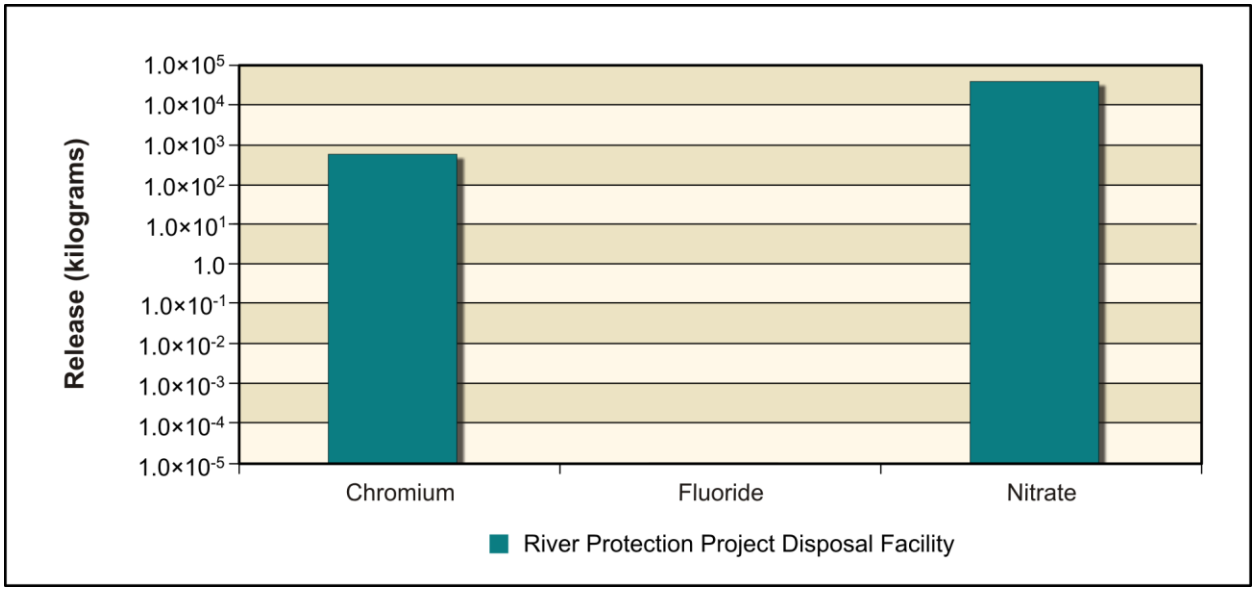


Figure 5–835. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Columbia River

Overall, most (greater than 99 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate reach the Columbia River during the period of analysis.

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–109 shows the maximum concentrations in groundwater. The most impact occurs at the IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where maximum concentrations of technetium-99 and iodine-129 exceed their respective benchmark values. None of the other COPC benchmark concentrations are exceeded.

Table 5–109. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**1,160**	**13,200**	42	**1,370**	**1,670**	900
	(11,434)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	**1.2**	**20.6**	0.1	**2.1**	**2.4**	1
	(11,054)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	19	1	3	6	5	100
	(11,378)	(3813)	(3740)	(10,691)	(11,049)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	11,500	7	180	3,150	2,400	45,000
	(8207)	(3927)	(3670)	(8121)	(7899)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–836 through 5–839 show concentration versus time for technetium-99, iodine-129, chromium, and nitrate. The releases of technetium-99 from IDF-East, IDF-West, and the RPPDF result in concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore that exceed the technetium-99 benchmark concentration over about 20 percent of the period of analysis (see Figure 5–836). After the post-disposal period, there is a short period (about 2,000 years) when technetium-99 concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore exceed the benchmark concentration. Technetium-99 concentrations then decrease for the duration of the 10,000-year analysis period. Technetium-99 concentrations at the IDF-East barrier reach the benchmark concentration in about CY 8900 and remain steady at this level for the 10,000-year period of analysis. The IDF-East, IDF-West, Core Zone Boundary, and Columbia River nearshore concentrations never exceed the benchmark concentrations by more than one order of magnitude.

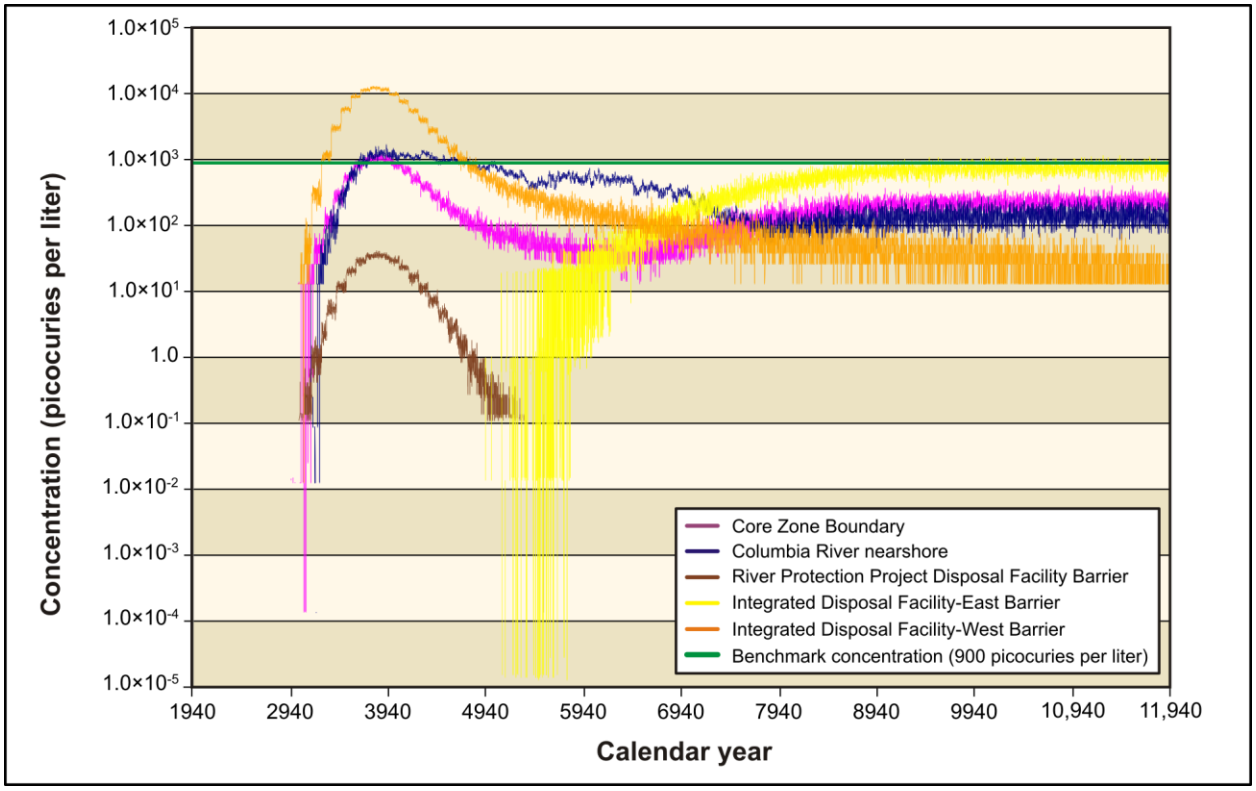


Figure 5–836. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Technetium-99 Concentration Versus Time

The iodine-129 concentrations (see Figure 5–837) at the IDF-West barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore have a similar time-versus-concentration profile as technetium-99. The initial IDF-West barrier iodine-129 peak is between one and two orders of magnitude over the benchmark concentration, and concentrations at the Core Zone Boundary and Columbia River nearshore are less than one order of magnitude above the benchmark. After the initial IDF-West iodine-129 peak, the concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore remain about one order of magnitude below the benchmark concentration. Iodine-129 concentrations at the IDF-East barrier reach the benchmark concentration in approximately CY 9000 and remain constant for the 10,000-year period of analysis.

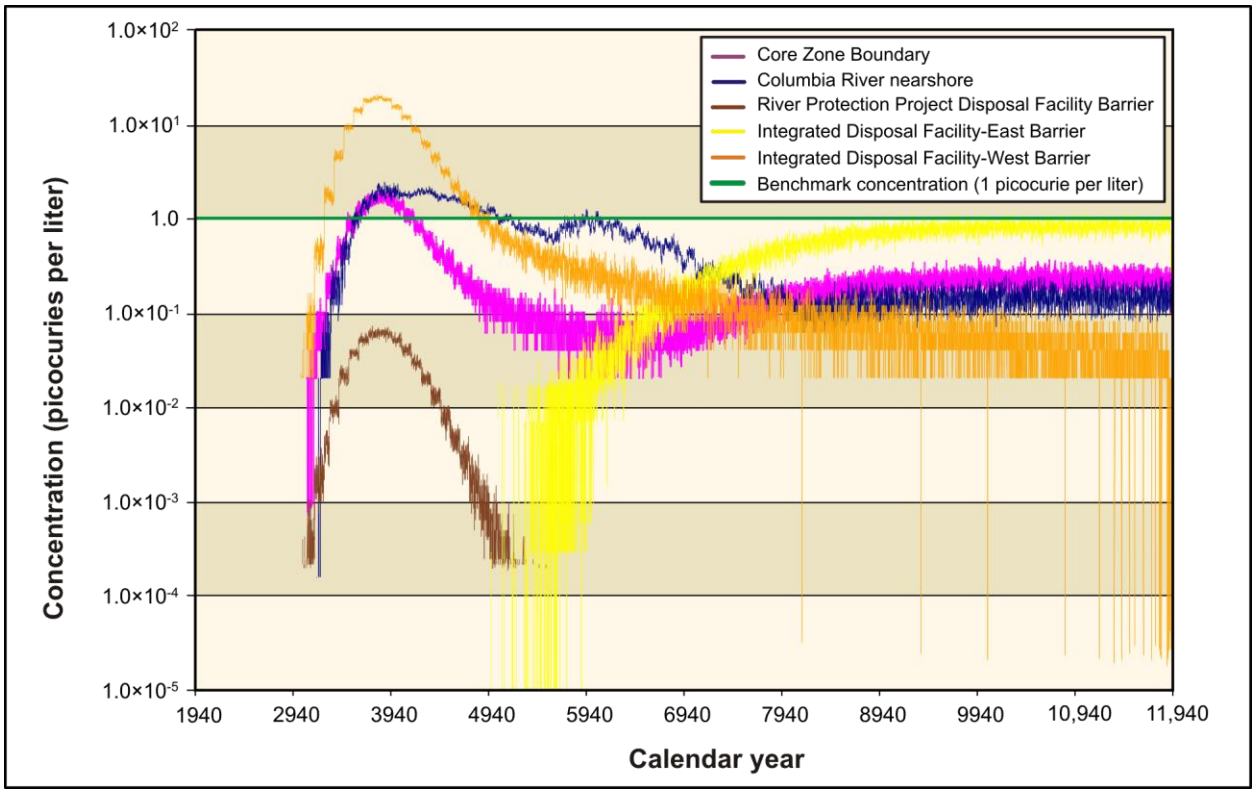


Figure 5–837. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Iodine-129 Concentration Versus Time

The time-versus-concentration profiles for chromium and nitrate (see Figures 5–838 and 5–839) also show initial peaks at the IDF-East barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore. However, unlike technetium-99 and iodine-129, these peaks are less than the respective benchmark concentrations. Both chromium and nitrate concentrations gradually increase through the latter half of the analysis period because of the rise in concentrations at the IDF-East barrier. The chromium and nitrate concentrations are always at least one order of magnitude less than the benchmark concentration.

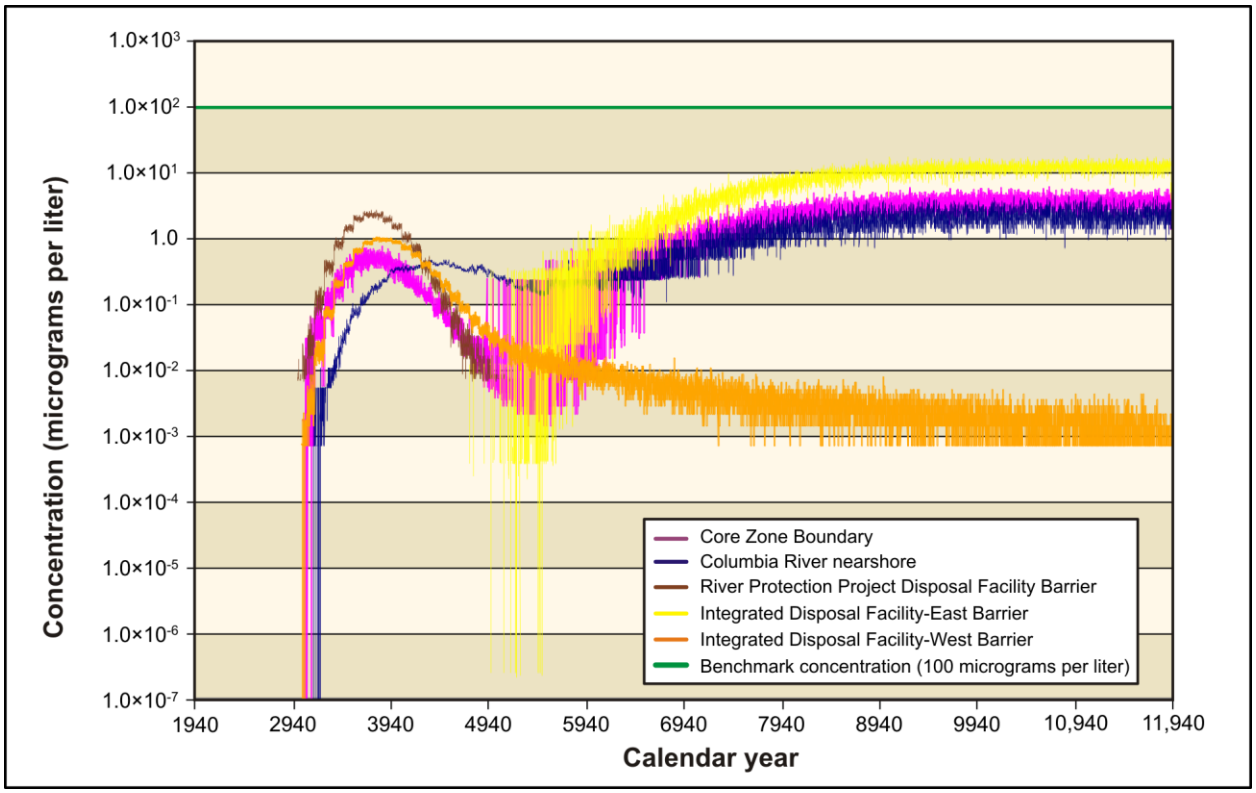


Figure 5–838. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chromium Concentration Versus Time

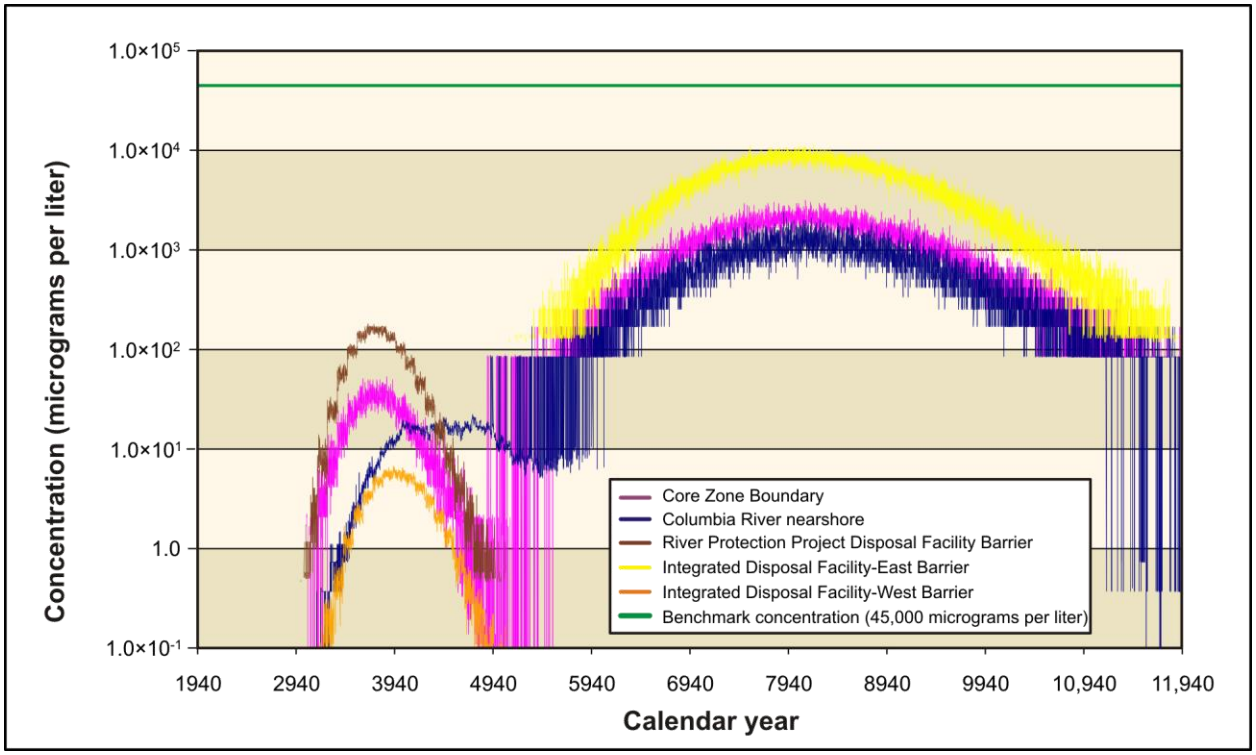


Figure 5–839. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Nitrate Concentration Versus Time

Figure 5–840 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are always lower than the benchmark concentrations over the period of analysis. Total uranium (see Figure 5–840) shows increasing concentrations at the RPPDF barrier and Core Zone Boundary that occur late in the analysis, around CY 10,000. Total uranium concentrations remain more than seven orders of magnitude below the benchmark concentration.

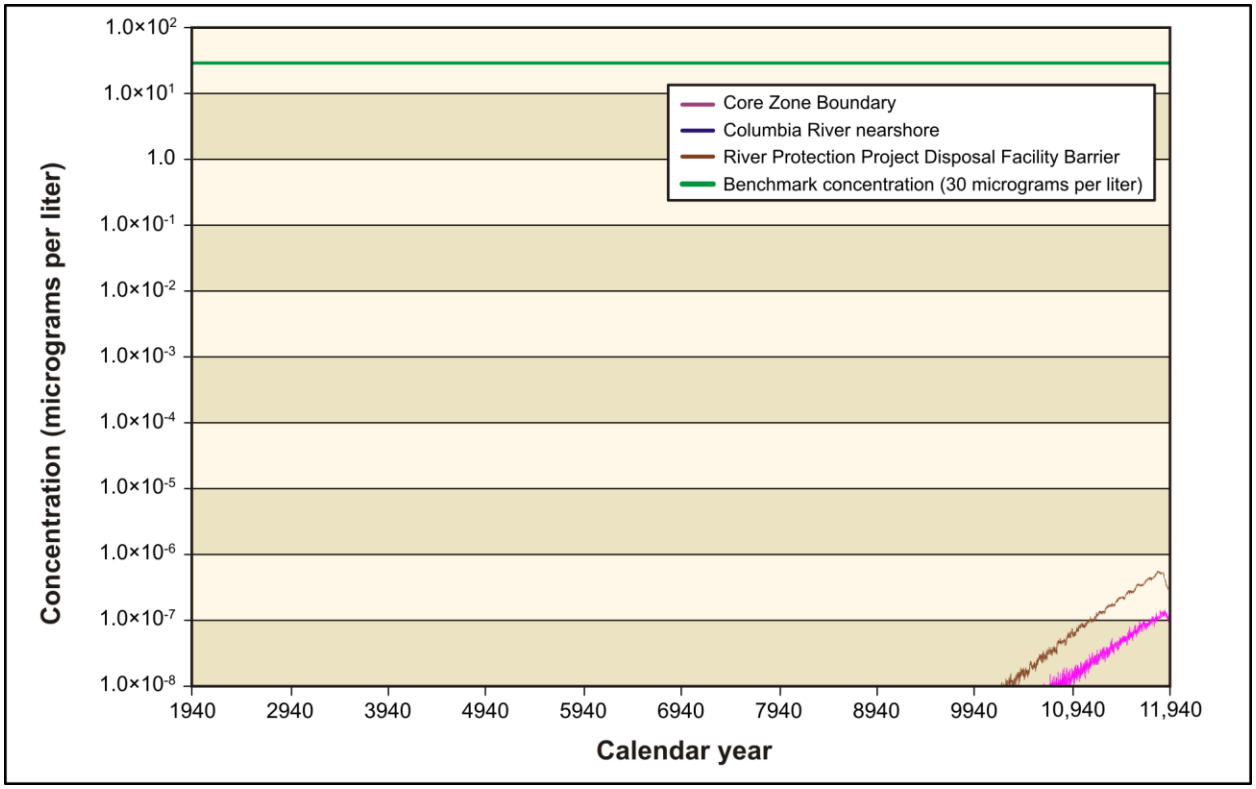


Figure 5–840. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Total Uranium Concentration Versus Time

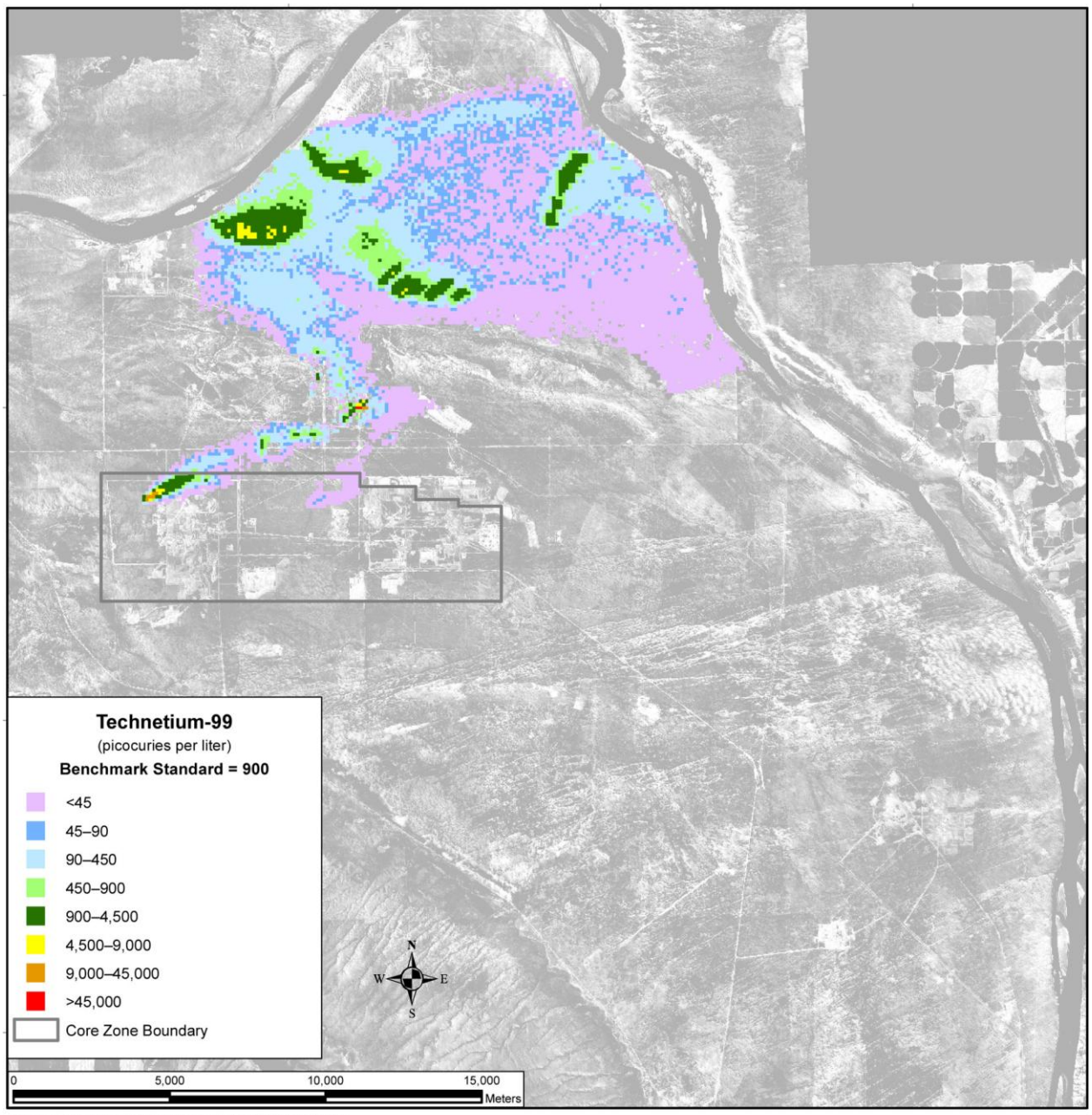
ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–841 through 5–852 show concentration distributions in CYs 3890, 7140, and 11,885 for technetium-99, iodine-129, nitrate, and chromium. These data show the groundwater releases from the RPPDF and IDF-West that extend north from within the Core Zone to the Columbia River. The IDF-East groundwater releases occur later and extend east from within the Core Zone to the Columbia River. The RPPDF and IDF-West releases remain in a fairly narrow channel (Gable Gap) until about halfway to the Columbia River nearshore boundary. The releases then spread out over the northern tip area of Hanford. The IDF-East releases remain in a relatively narrow channel until they reach about the one-quarter

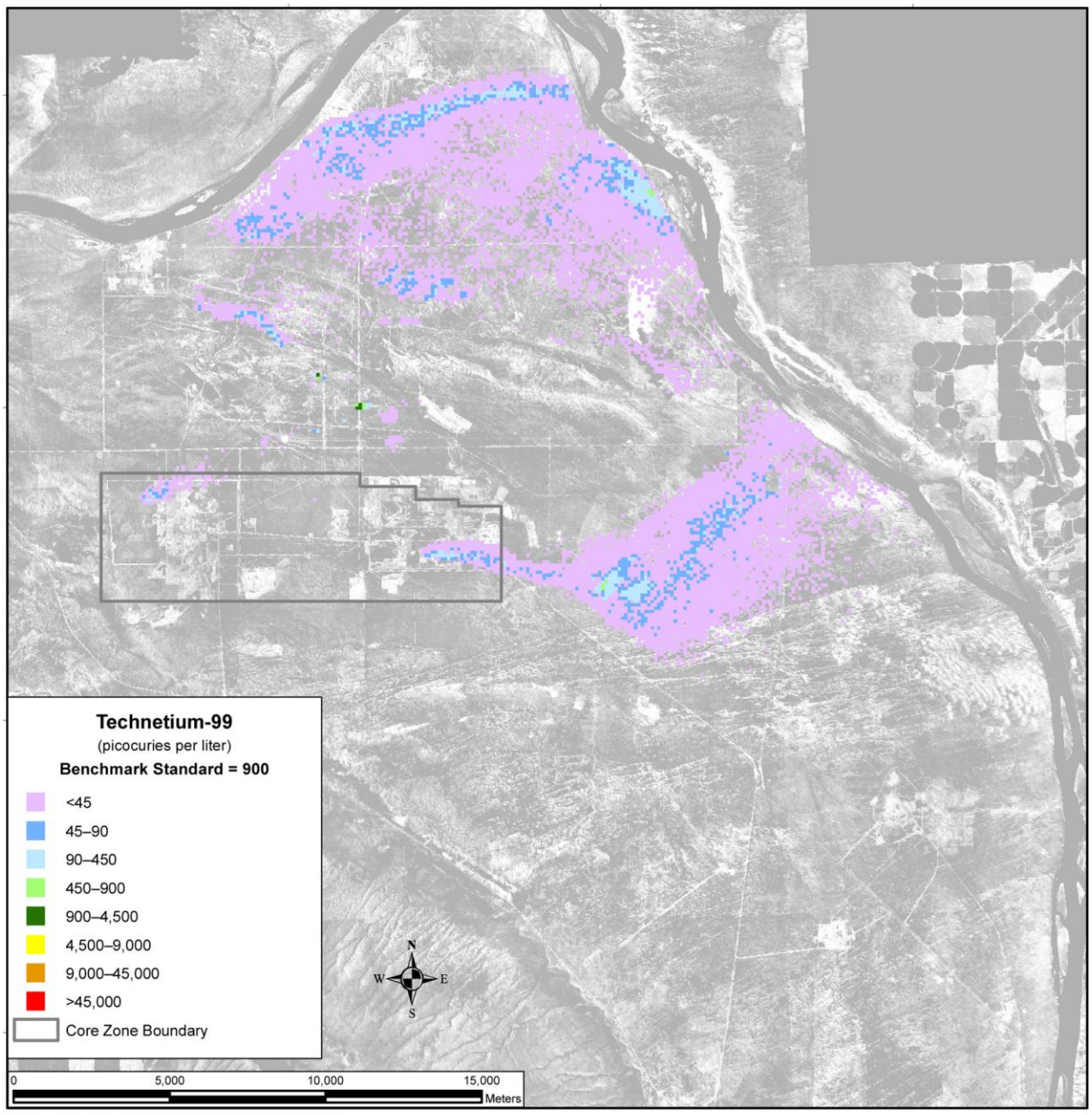
distance point to the Columbia River, where the releases spread out and continue to the Columbia River nearshore boundary.

Figure 5–841 shows the technetium-99 release from IDF-West and the RPPDF in CY 3890. This spatial distribution shows that technetium-99 exceeds the benchmark concentration within the Core Zone (due to the IDF-West release) and in several areas close to the Columbia River nearshore. Figure 5–842 shows that the technetium-99 release from IDF-West and the RPPDF has largely dissipated by CY 7140 and only exists in areas close to the Columbia River nearshore at concentrations at least one order of magnitude lower than the benchmark concentration. This figure also shows a technetium-99 release distribution from IDF-East. There are small areas where technetium-99 approaches the benchmark concentration. Figure 5–843 shows that the IDF-West and RPPDF groundwater technetium-99 is almost completely dissipated in CY 11,885. In CY 11,885, technetium-99 has continued to move to the Columbia River. There are several areas where the IDF-East release still approaches or exceeds the benchmark concentration within one order of magnitude.



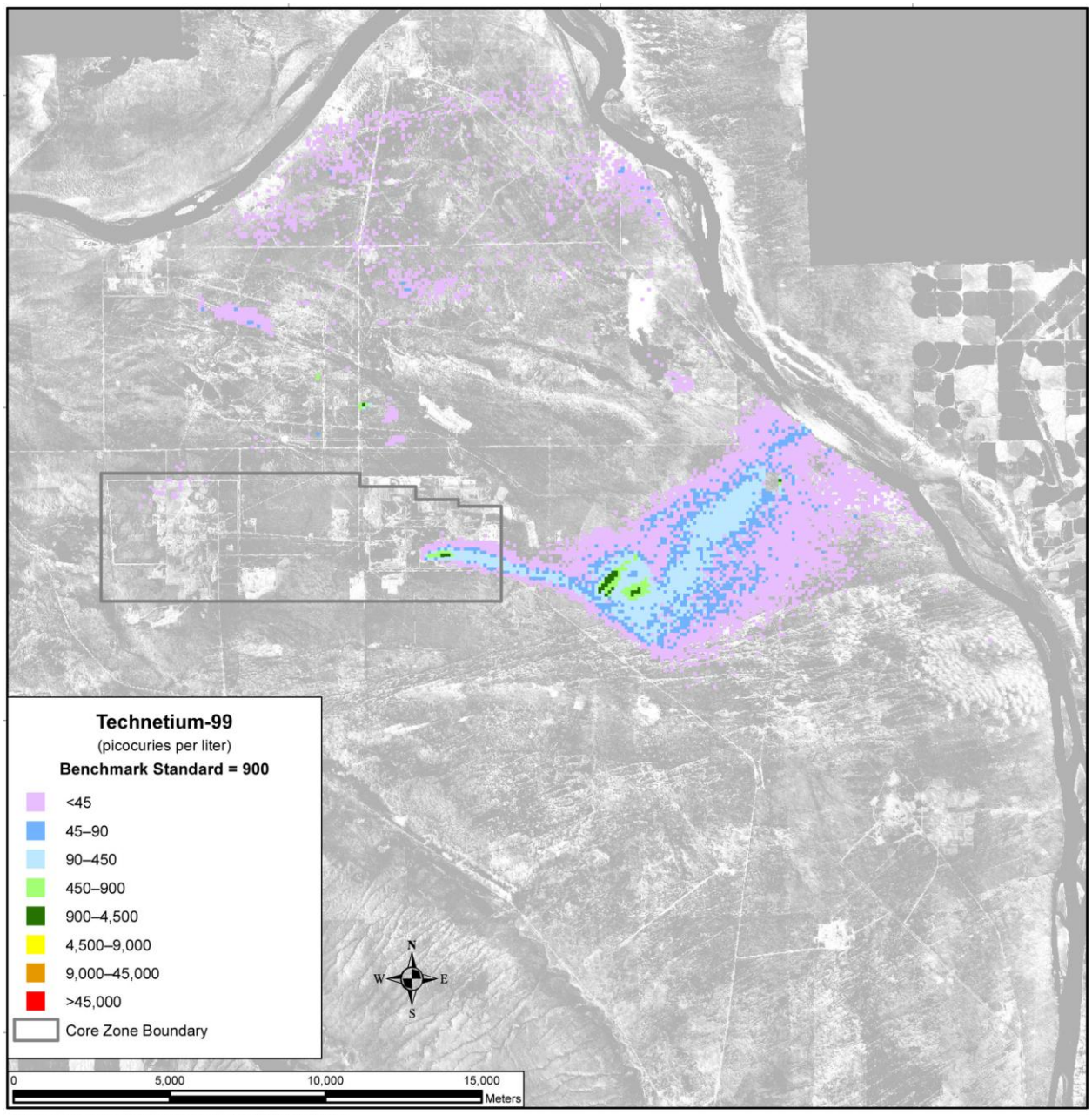
Note: To convert meters to feet, multiply by 3.281.

Figure 5–841. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

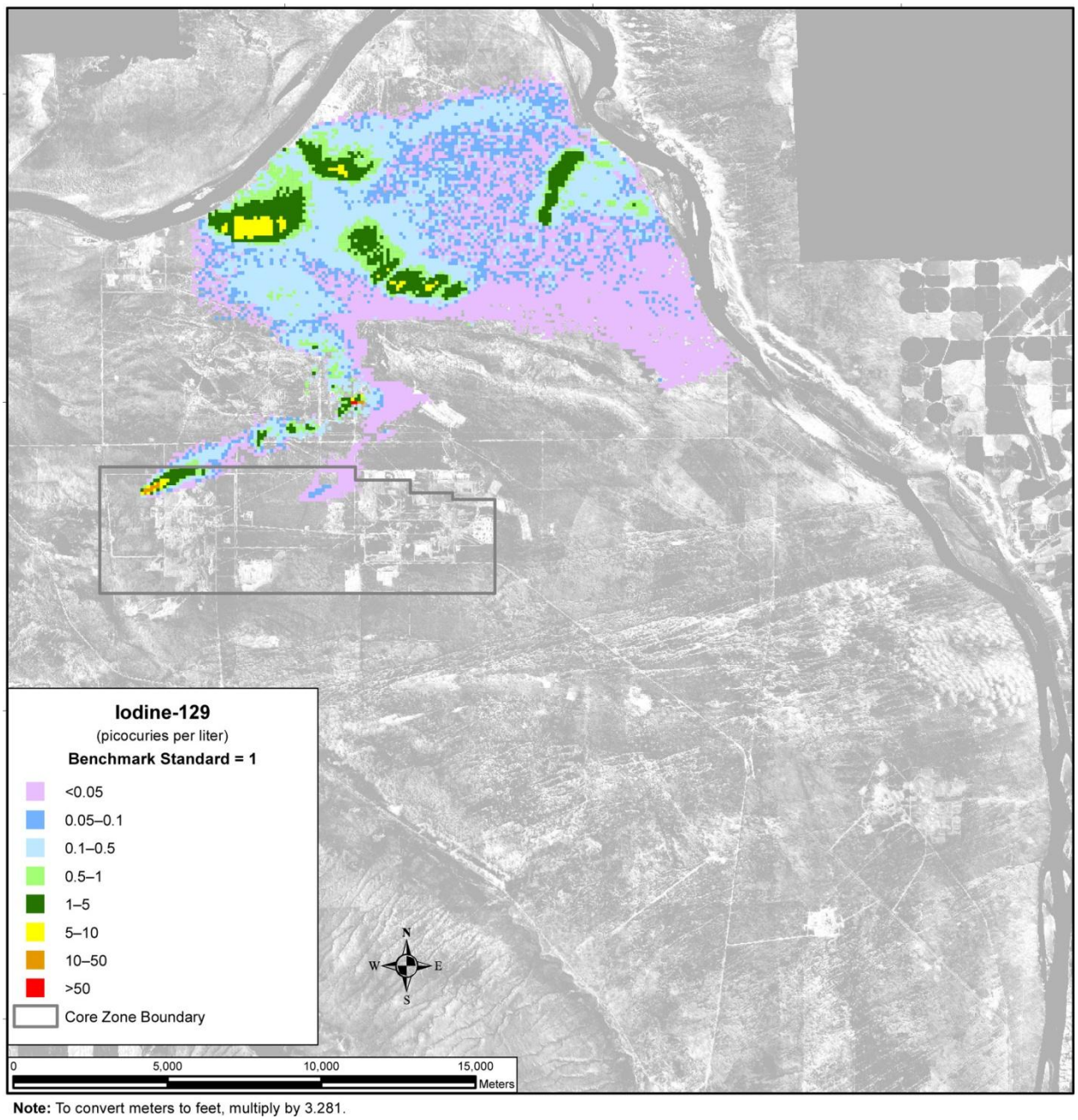
Figure 5–842. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

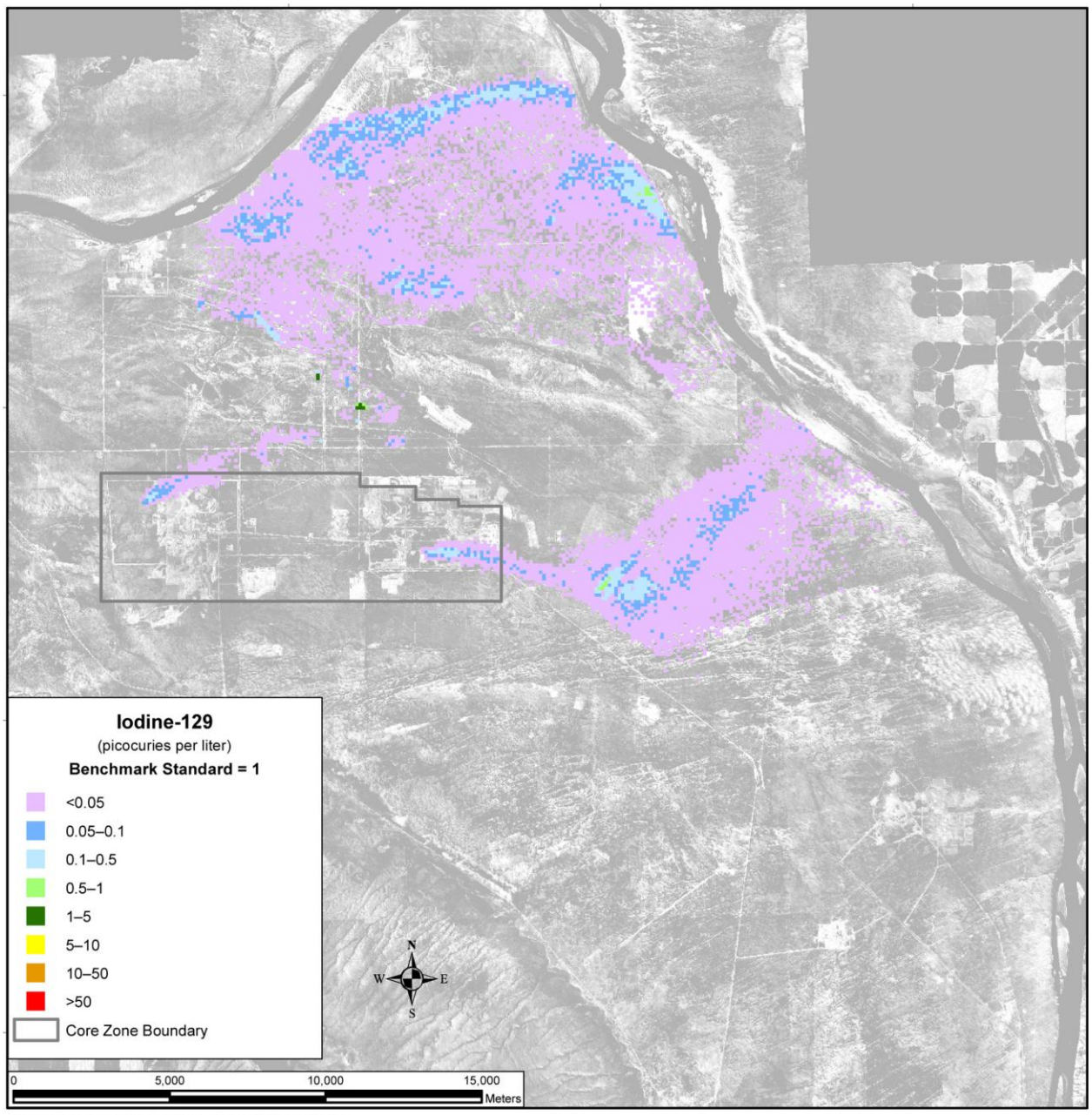
Figure 5–843. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

Figures 5–844 through 5–846 show iodine-129 released from IDF-East, IDF-West, and the RPPDF; the time and spatial distributions of this release are very similar to the technetium-99 release. However, the CY 3890 iodine-129 release (see Figure 5–844) shows significantly higher iodine-129 concentrations compared to benchmark concentrations than the technetium-99 release. The areas of high concentrations are in approximately the same locales but have relatively higher concentrations. By CY 7140 (see Figure 5–845), concentrations of IDF-West and RPPDF iodine-129 have significantly dissipated, but there are areas where concentrations are equal to or above the benchmark concentration. The CY 11,885 IDF-East iodine-129 (see Figure 5–846) shows a continuing iodine-129 distribution, with areas that have concentrations that approach or exceed the benchmark concentration.



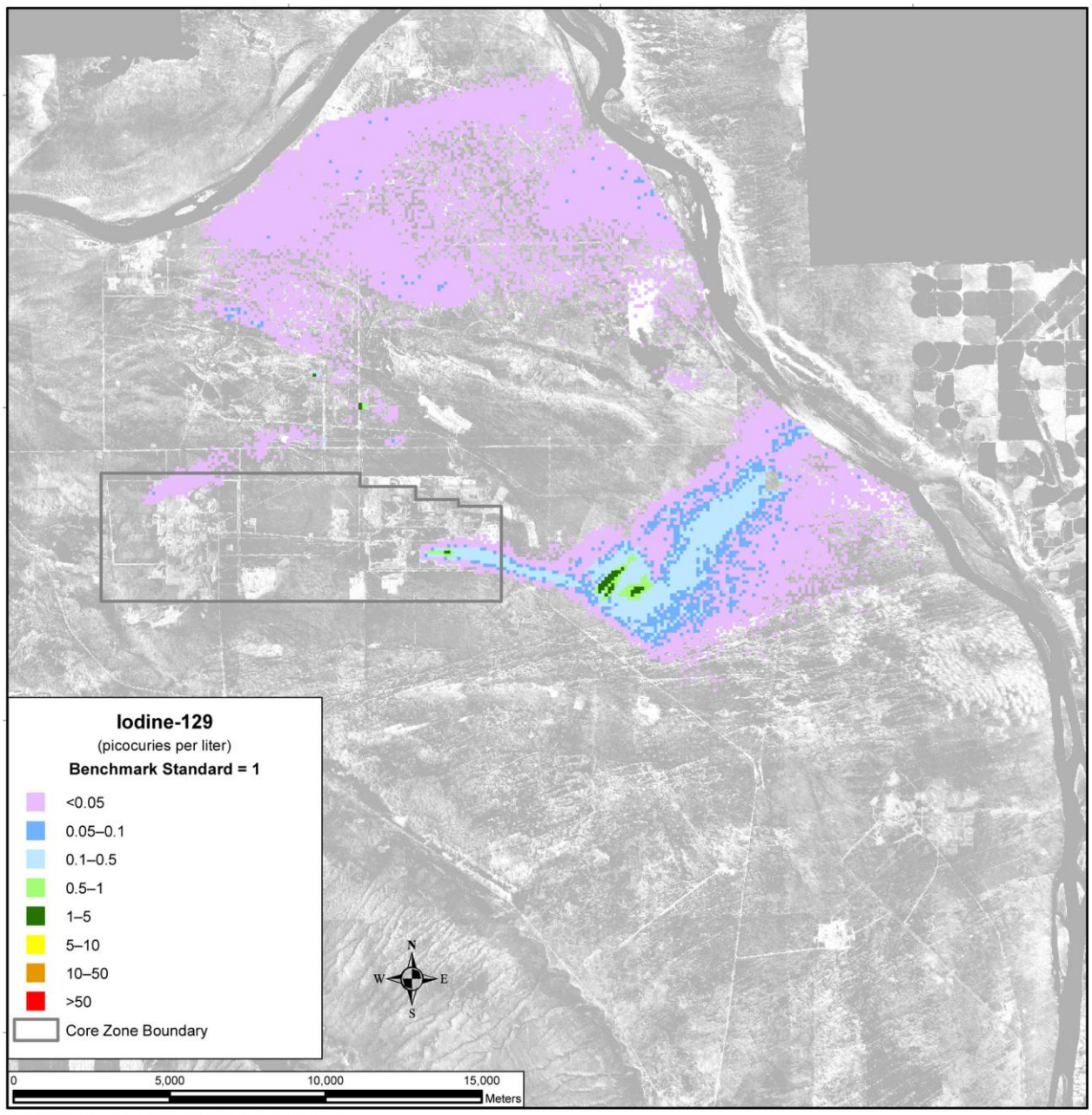
Note: To convert meters to feet, multiply by 3.281.

Figure 5–844. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

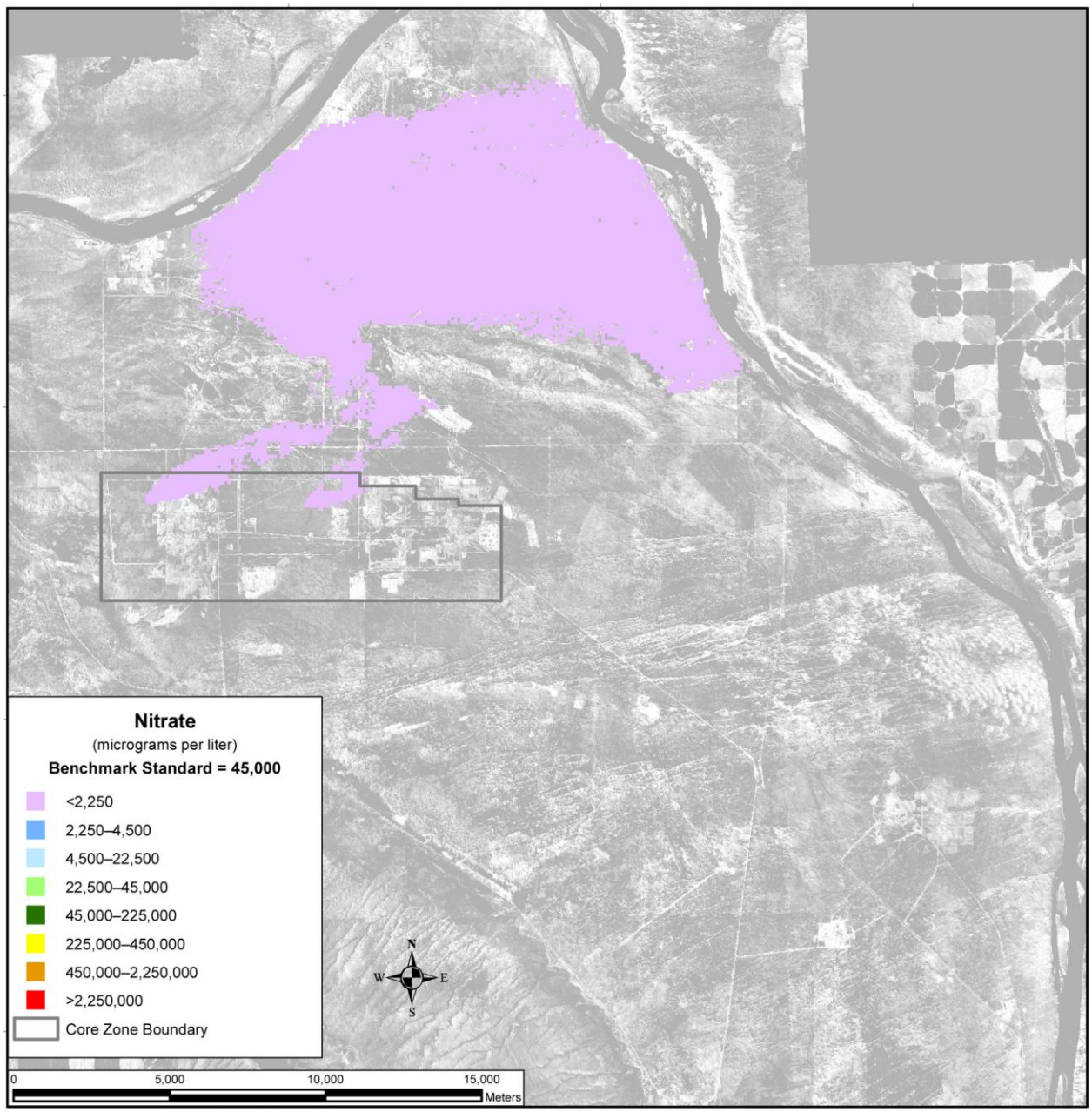
Figure 5–845. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

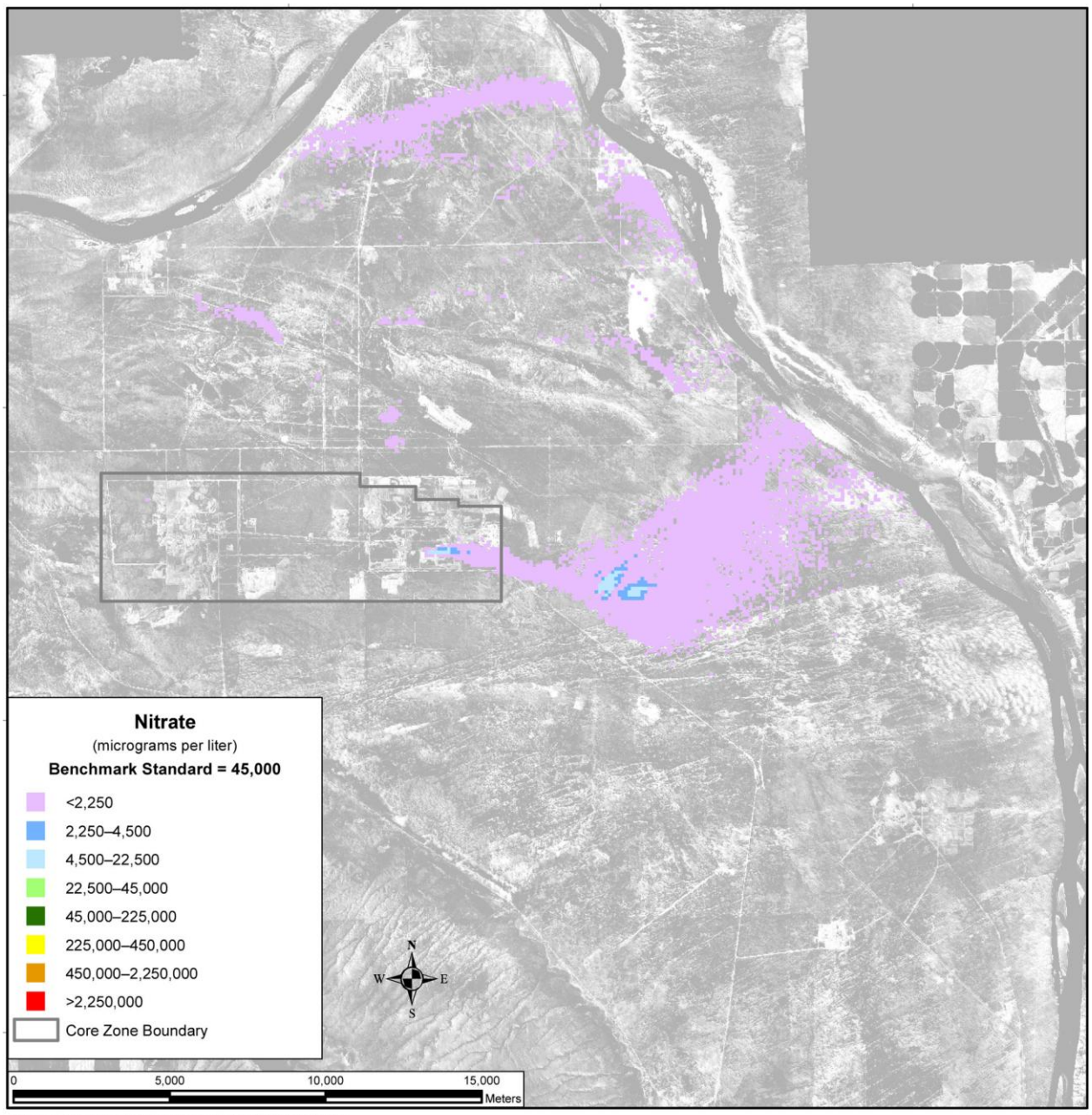
Figure 5–846. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885

The IDF-East, IDF-West, and RPPDF nitrate releases, shown in Figures 5–847 through 5–849, show time and spatial distributions similar to the released technetium-99 and iodine-129. These show that nitrate concentrations are below benchmark concentrations. By CY 11,885, almost all of the groundwater nitrate has dissipated.



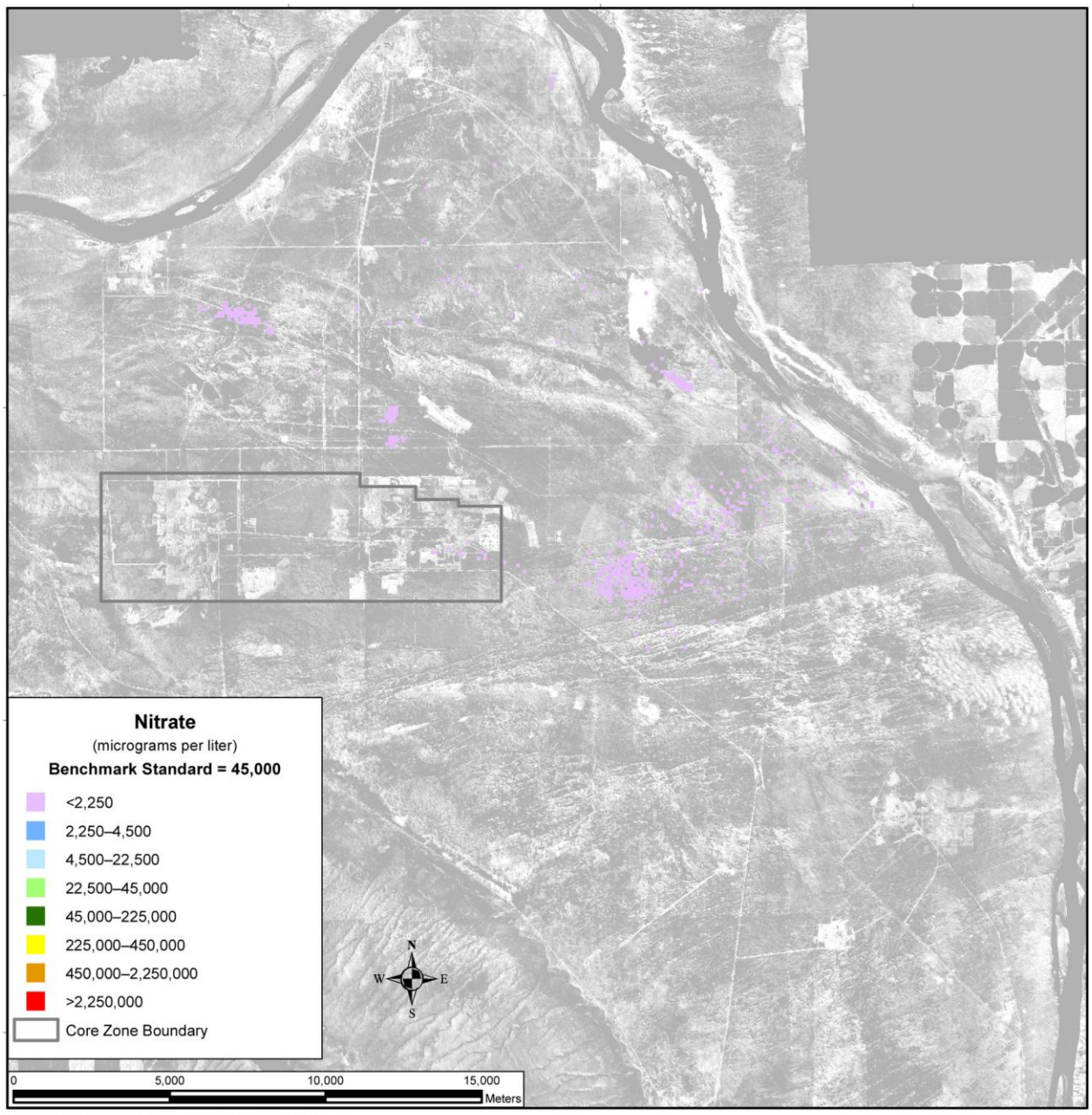
Note: To convert meters to feet, multiply by 3.281.

Figure 5–847. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

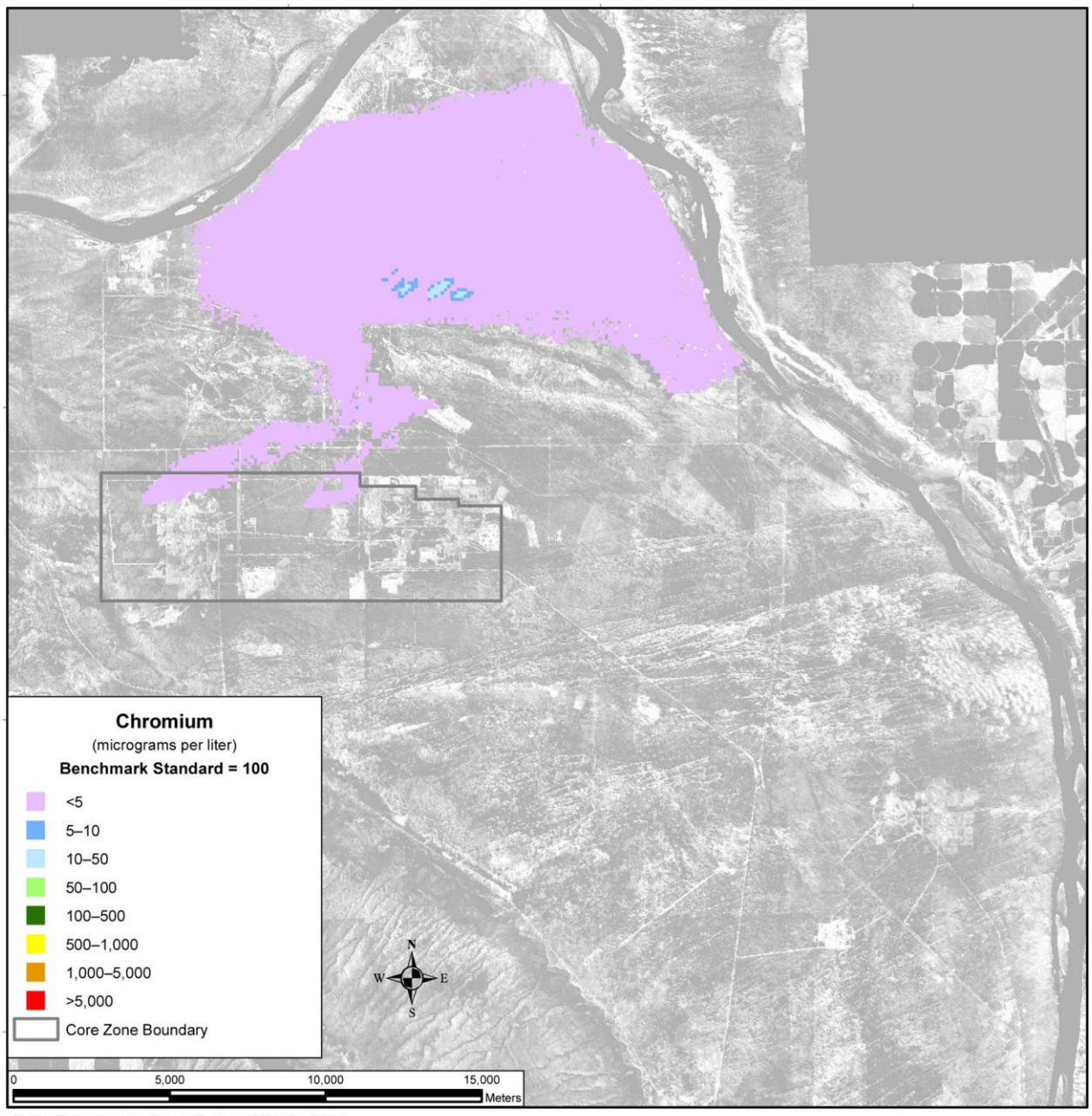
Figure 5–848. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

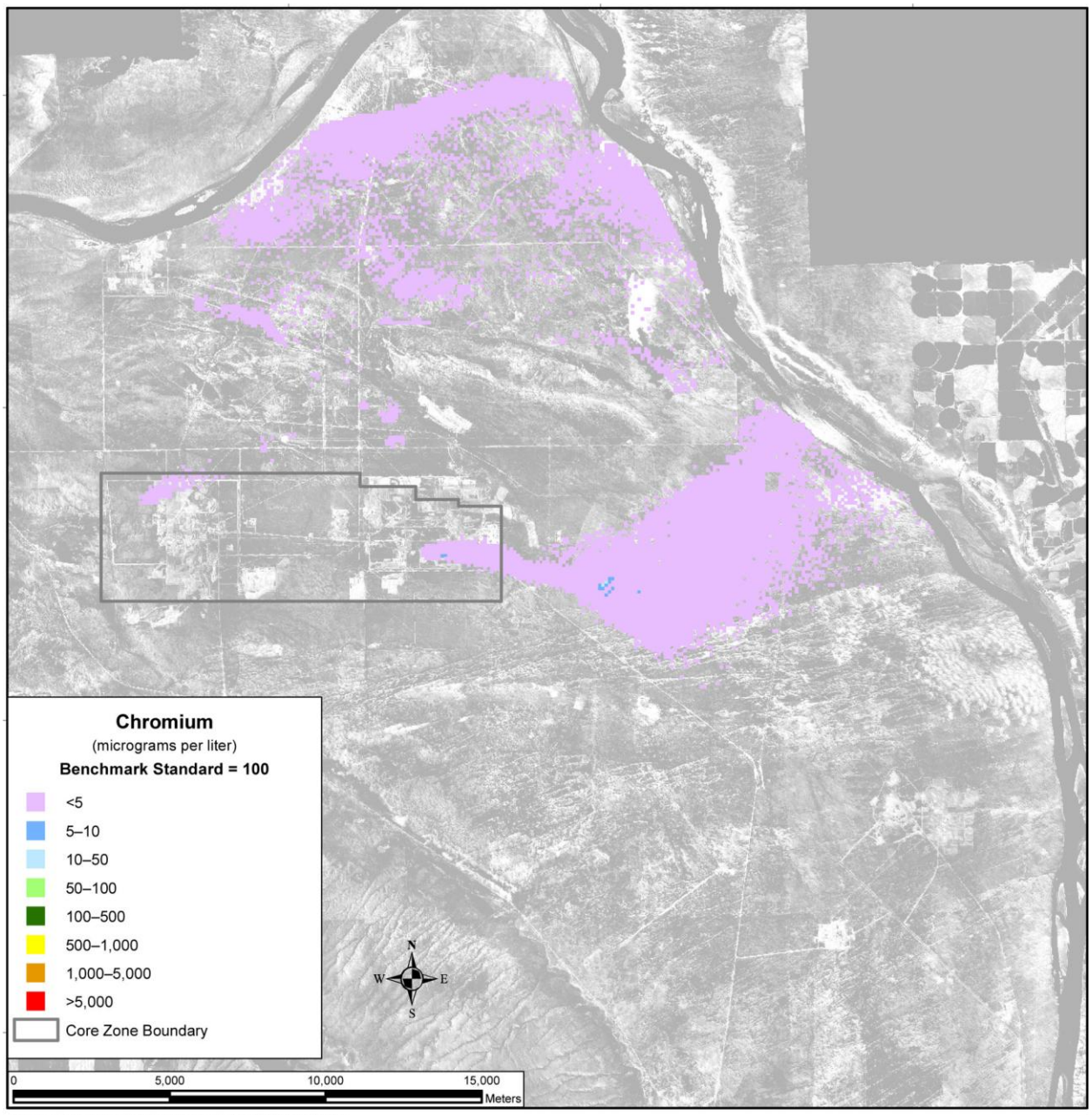
Figure 5–849. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

The CY 3890 and CY 7140 chromium releases in Figures 5–850 and 5–851 are similar to the respective nitrate releases. Chromium concentrations appear to approach the benchmark concentration in some areas north of Gable Mountain, at the IDF-East barrier, and east of the Core Zone Boundary. By CY 11,885 (see Figure 5–852), the chromium release has dissipated, but a significant amount of chromium remains distributed between IDF-East and the Columbia River nearshore. Chromium released from IDF-West and the RPPDF has almost totally dissipated.



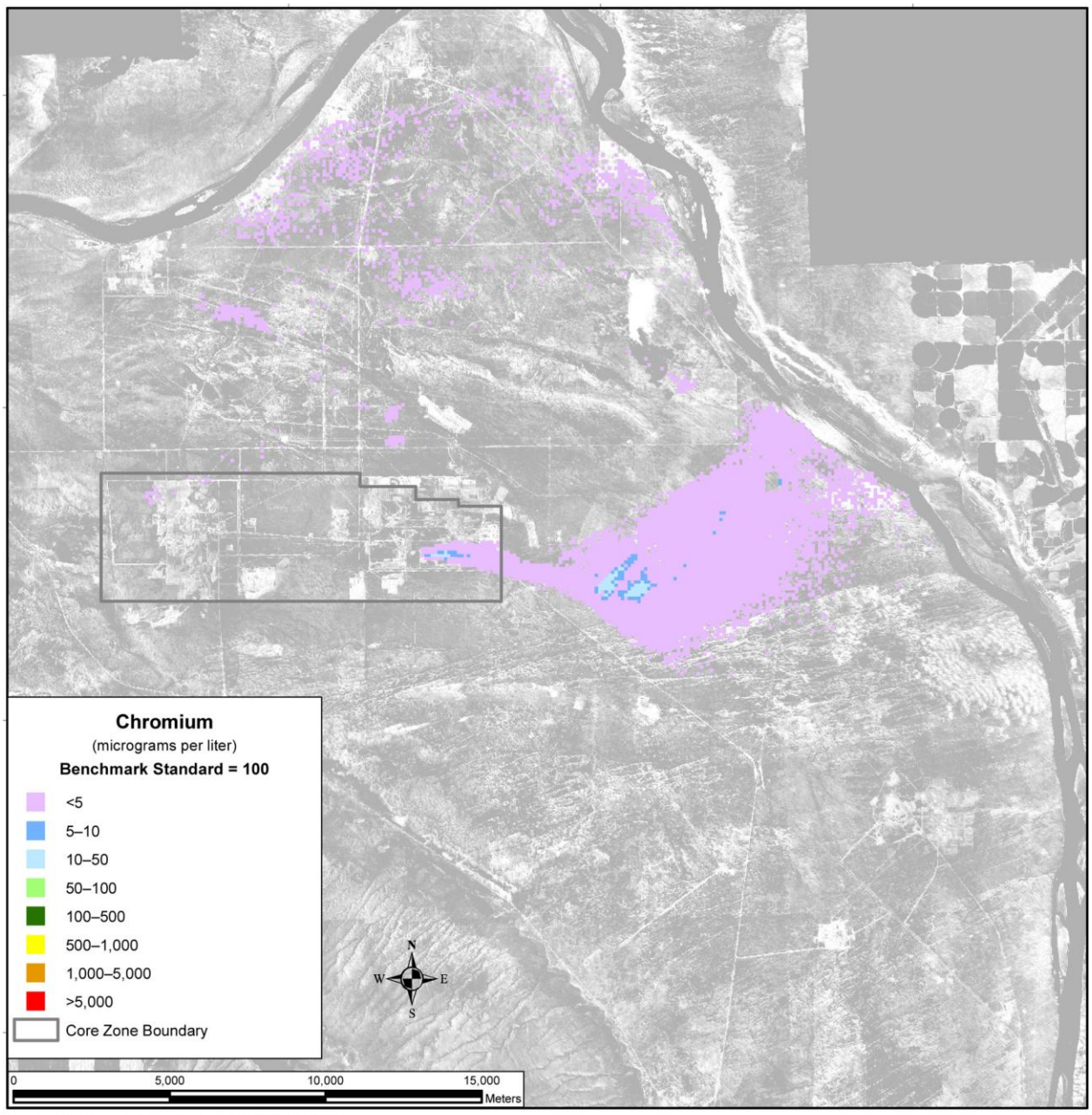
Note: To convert meters to feet, multiply by 3.281.

Figure 5–850. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–851. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–852. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

For Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in general, the inventory remaining in IDF-West is the predominant contributor. The releases from IDF-East and the RPPDF are secondary contributors.

By the end of this period of analysis (CY 11,885), the chromium and nitrate distributions have largely dispersed below their benchmark concentrations. Significant spatial distributions of technetium-99 and iodine-129 remain. Most of the distribution area has concentrations below benchmark levels, but there are some small areas where technetium-99 and iodine-129 concentrations exceed the benchmark levels in

CY 11,885. The released iodine-129, which occurs at higher concentration levels relative to its benchmark than technetium-99, dissipates much more quickly than technetium-99.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species do not exceed their benchmark levels at the Core Zone Boundary or Columbia River nearshore over this period of analysis. However, the spatial distributions of both uranium-238 and total uranium exist through the end of the analysis period (CY 11,885). Although the concentrations of uranium-238 and total uranium are both seven orders of magnitude smaller than either benchmark concentration during this analysis period, the trend appears to show a continuing increase through the end of the analysis period.

5.3.1.3.1.5 Disposal Group 1, Subgroup 1-E

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, was designed to accommodate disposal of waste generated under Tank Closure Alternative 4 and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW, ILAW glass, bulk vitrification glass, and cast stone waste.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, nitrate, and acetonitrile) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–853 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–854, the chemical hazard drivers. The inventories in the six waste forms are a major factor in the release quantities to the vadose zone. The predominant source of vadose zone technetium-99 is cast stone waste (93 percent), with the remainder coming from bulk vitrification glass (5 percent) and tank closure secondary waste (1 percent). The vadose zone iodine-129 is from ETF-generated secondary waste (75 percent) and cast stone waste (22 percent), as well as tank closure secondary waste (2 percent). The predominant source of chromium (greater than 99 percent) is cast stone waste. The sources of nitrate release to the vadose zone are cast stone waste (84 percent) and ETF-generated secondary waste (16 percent). Fluoride is not released from IDF-East.

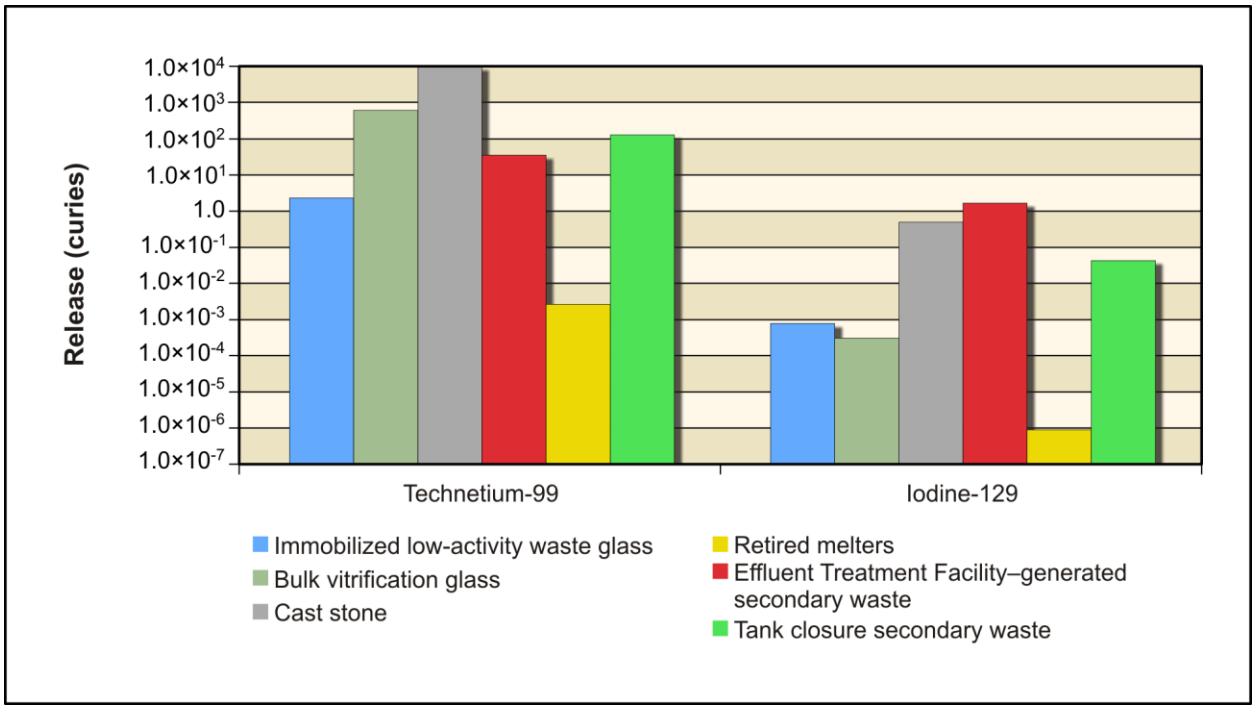


Figure 5–853. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

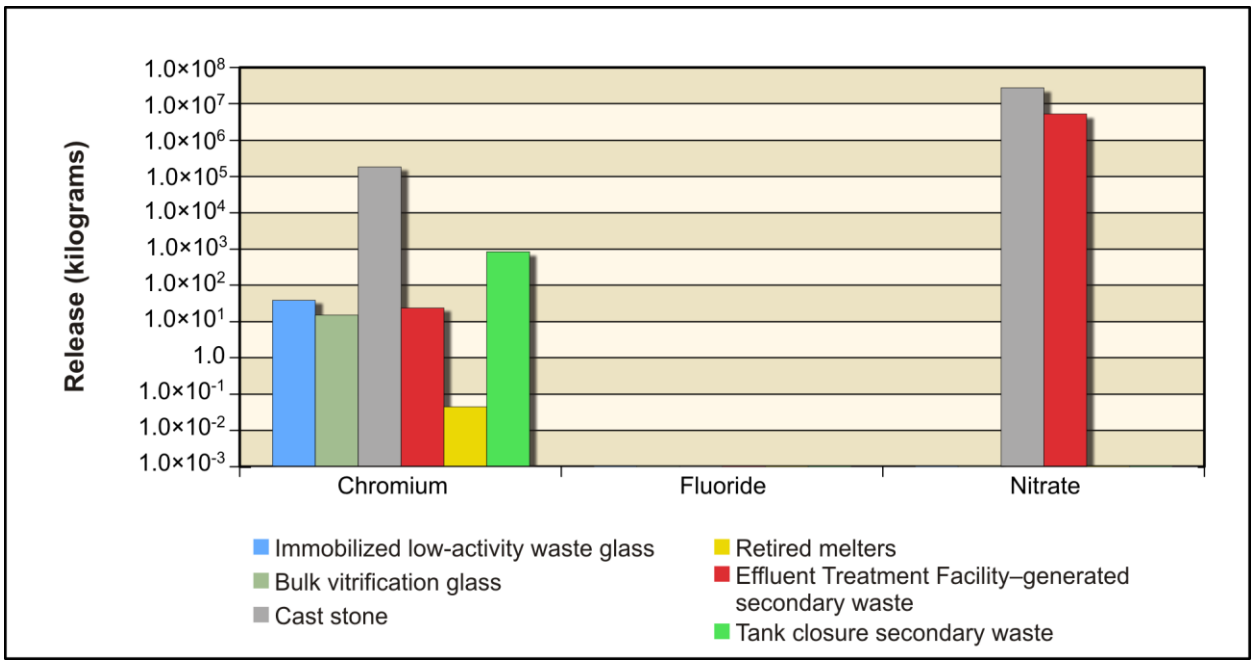


Figure 5–854. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–855 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–856, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. The vadose zone releases some technetium-99 (48 percent) and iodine-129 (43 percent) to groundwater. Nearly all (99 percent) of the vadose zone chromium and nitrate are released to groundwater.

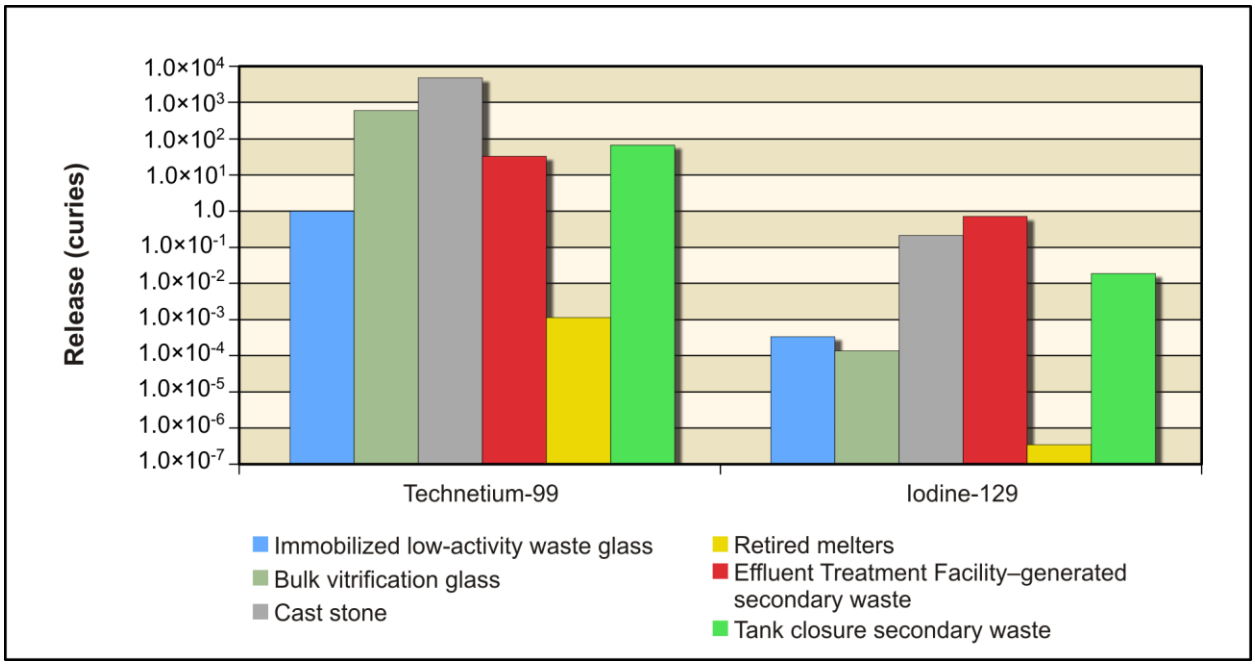


Figure 5–855. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

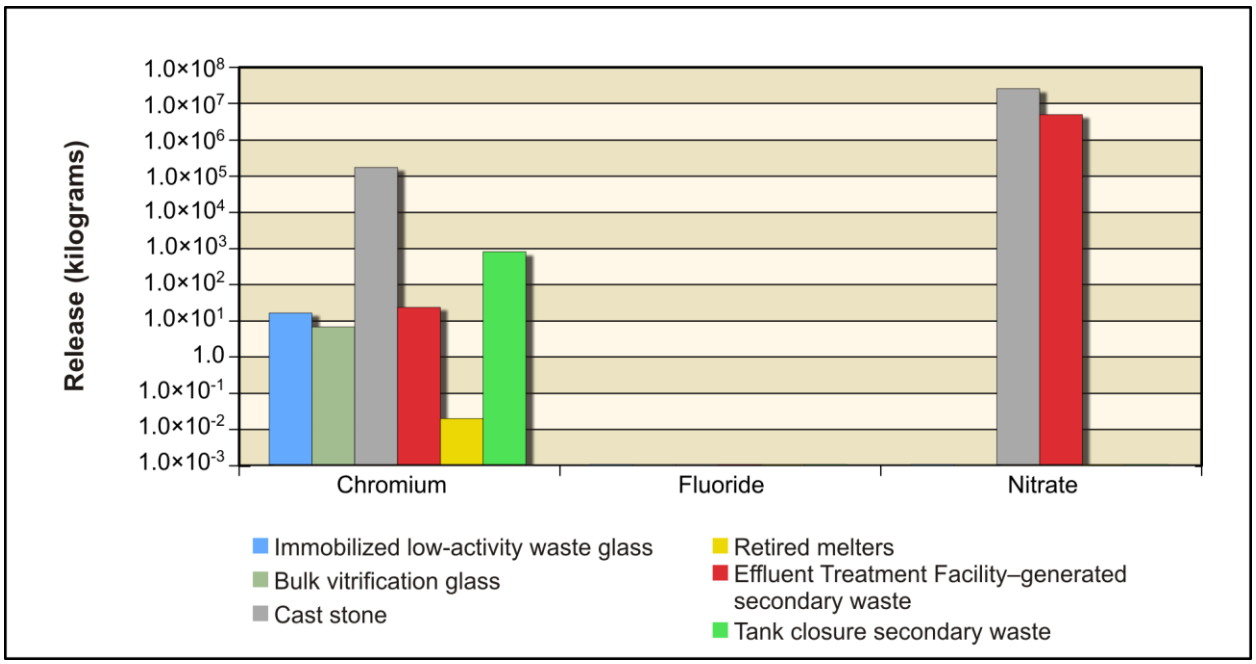


Figure 5–856. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–857 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–858, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. The groundwater releases most of its technetium-99 (97 percent), iodine-129 (96 percent), chromium (99 percent), and nitrate (99 percent) to the Columbia River.

Overall, most of the IDF-East vadose zone chromium (99 percent) and nitrate (99 percent) and some of the vadose zone technetium-99 (47 percent) and iodine-129 (41 percent) reach the Columbia River over the period of analysis.

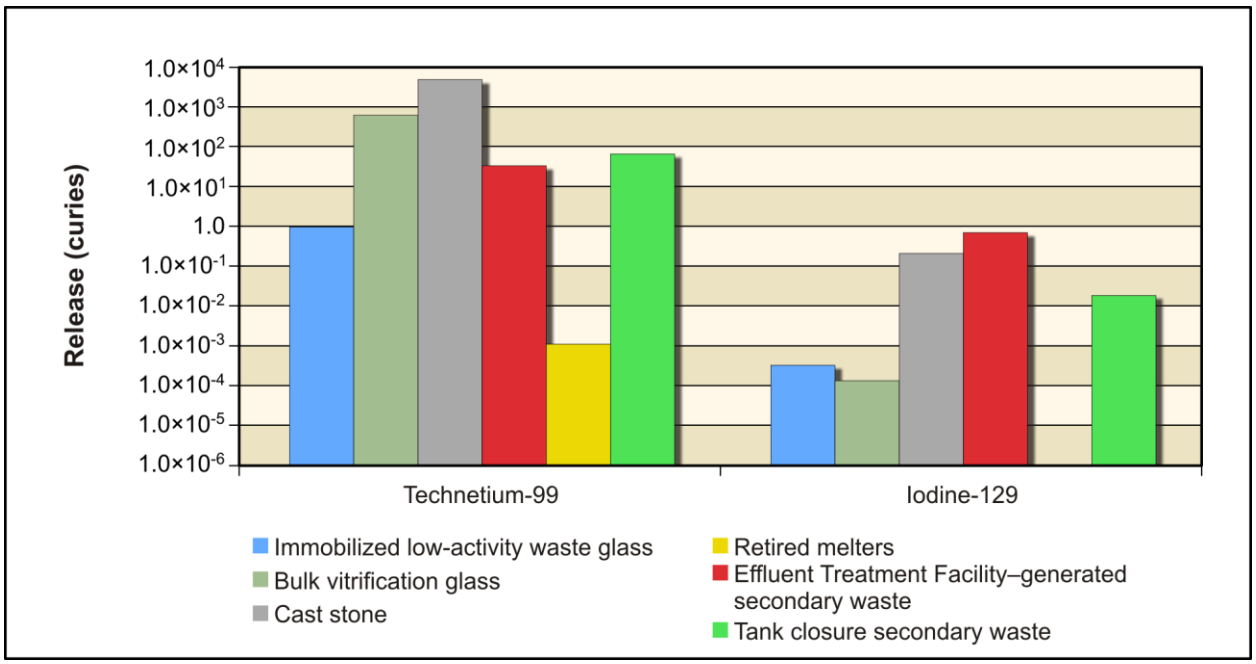


Figure 5–857. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

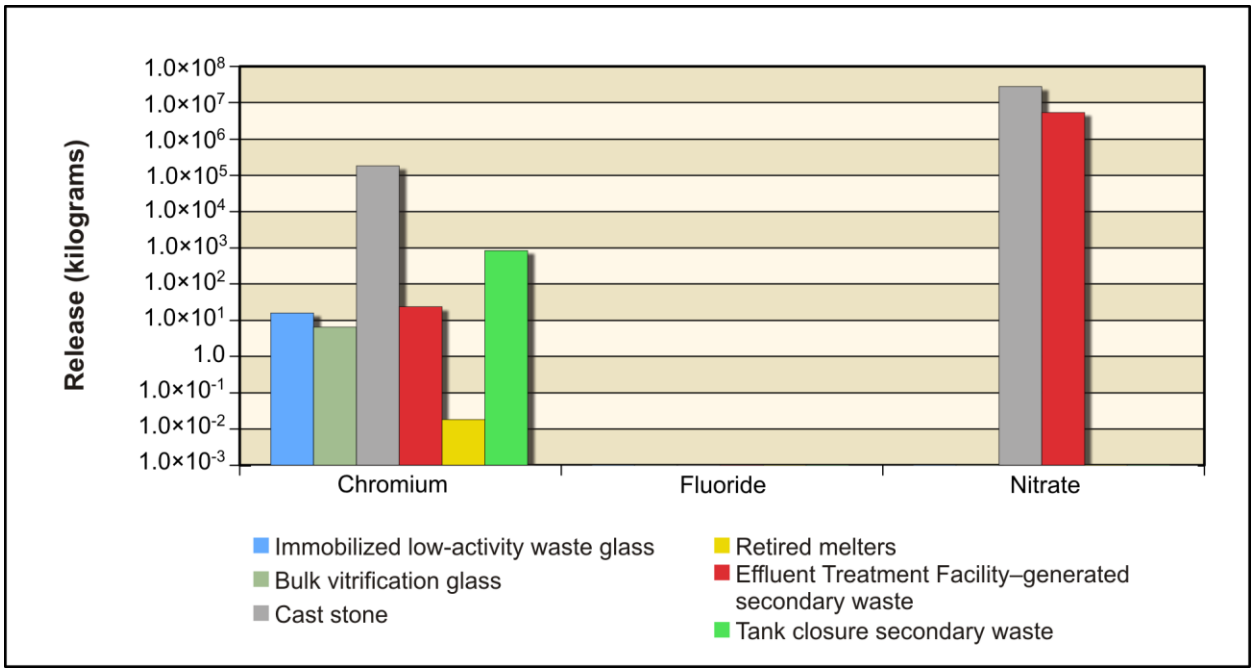


Figure 5–858. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–859 through 5–864, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–859 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–860, the chemical hazard drivers. The inventories in the three waste forms are a major factor in the release quantities to the vadose zone. Offsite waste is the predominant source of the technetium-99 (greater than 99 percent) and iodine-129 (greater than 99 percent) released to the vadose zone. Essentially all (greater than 99 percent) of the nitrate and fluoride that is released to the vadose zone is from waste management secondary waste and onsite waste. Chromium released to the vadose zone is from waste management secondary waste and onsite waste (69 percent) and offsite waste (31 percent).

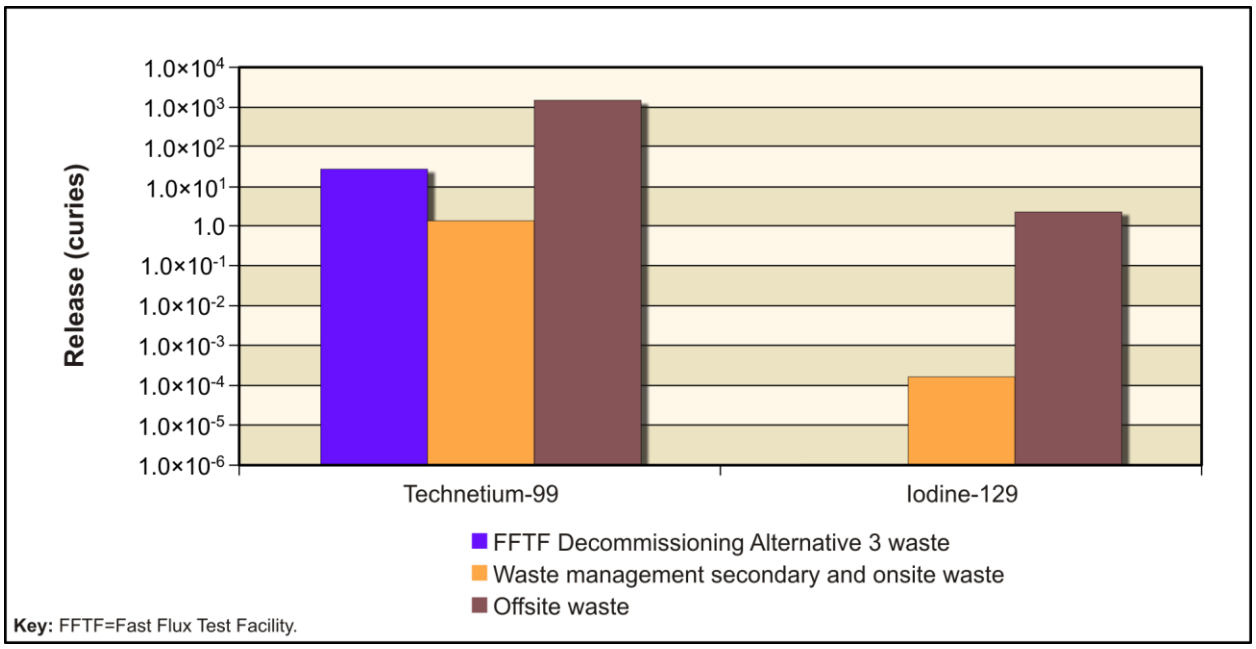


Figure 5–859. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

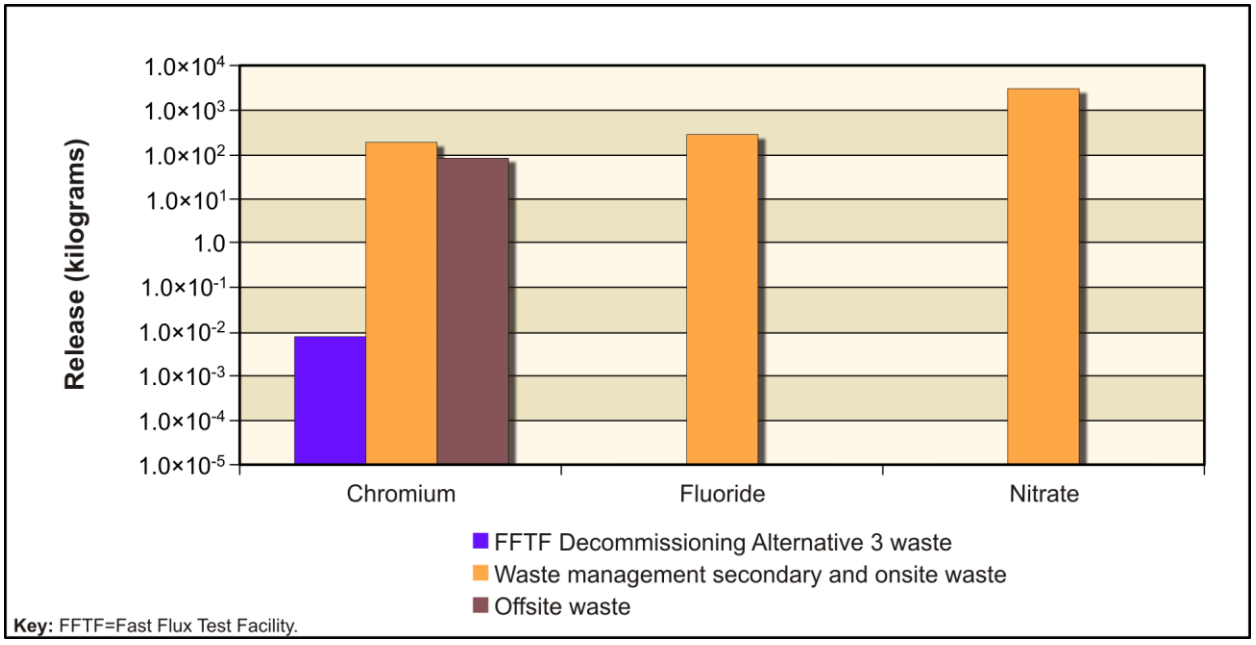


Figure 5–860. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone